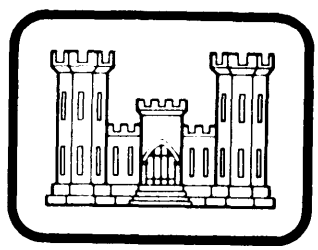
SOUTHEASTERN NEW HAMPSHIRE

WATER RESOURCES STUDY

RECONNAISSANCE REPORT



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

MAY 1979

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PREFACE

This Reconnaissance Report concludes Stage I of the Southeastern New Hampshire Water Resources Study, which was carried out to determine the advisability of developing the area's water resources.

The problems identified during Stage I are water supply, water quality, flood damage reduction, navigation and recreation. They were identified through a series of public workshops and meetings with Federal, State, regional and local agency representatives and special interest groups. Each concern was investigated to determine the magnitude of the problem.

Based on the investigations to date, it is concluded that continuing a water resources study into Stage II is warranted. At that time water resources plans would be developed to a general level of detail. Stage III, if found necessary, would continue the study to a level of detail necessary to evaluate and select a final water resources plan.

Severe water shortages are projected for southeastern New Hampshire within the study's 50-year time frame. Several communities can barely meet average day demands now. Determining the most efficient method of integrating surface and groundwater supplies to optimize use of area water resources has become the major goal of the study.

The following tasks would be performed during Stage II:

- Conduct a detailed assessment of the adequacy and suitability of water sources in the 1,000-square mile study area.
- Develop a regional management plan.
- Develop preliminary cost estimates for alternative water supply plans.
- Examine water conservation measures and savings possible through their implementation.
- Conduct a public involvement program to keep in touch with the needs and desires of persons living within the study area.
- Perform environmental and socio-economic impact assessments and evaluations of alternative plans.

- Carry out legal institutional and cost-sharing studies.

- Devise an implementation program that includes schedules, priorities and flexibility-reliability analyses.

The overall quality of groundwater in southeastern New Hampshire is still very good, but the quality of surface waters is a major problem. Lakes and rivers are being degraded by direct discharges of industrial and domestic sewage, overflows from inadequate sanitary and storm water sewerage systems, and storm water runoff deposits of sediment, fertilizers, pesticides and livestock droppings.

Plan development during Stage II would be fully coordinated with any water quality studies being conducted by other agencies. Water quality is a management responsibility of the State of New Hampshire under the regulatory authority of the U.S. Environmental Protection Agency.

Both riverine and coastal flooding have occurred in the study area. During Stage II existing reports would be reviewed and information applicable to flood damage reduction would be incorporated into the study.

Maintenance and other dredging may be necessary in Portsmouth Harbor, the study area's major commercial port. A study on the feasibility of widening the 35-foot channel there is currently being carried out by the Corps. Dredging in some of the local rivers and bays to facilitate pleasure boating is also a possibility. Existing commercial and recreational boating facilities would be assessed in Stage II and, if the need exists, regional plans for navigation improvements would be developed.

Recreation plans developed by the State and various regional planning agencies would be reviewed. Applicable recommendations would then be incorporated into water resources plans developed in this study.

All plans developed in the Southeastern New Hampshire Water Resources Study would be designed to meet long-range water resources needs through the year 2030. The entire three-stage study, if carried out, is scheduled for completion in late 1981.

SOUTHEASTERN NEW HAMPSHIRE

WATER RESOURCES STUDY

RECONNAISSANCE REPORT

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SECTION I

JUSTIFICATION FOR THE STUDY

SECTION I - JUSTIFICATION FOR THE STUDY

A. INTRODUCTION

In July 1976, the Corps of Engineers completed an overall water supply assessment for Southeastern New Hampshire under the authority of Section 22 of the Water Resources Development Act (PL 93-251). The resulting report, entitled "Southeast New Hampshire Water Supply Study," addressed existing water supply source capabilities, future populations and water demands and potential ground and surface water sites.

As a result of this investigation a resolution was proposed by Congressman James C. Cleveland requesting the Board of Engineers for Rivers and Harbors to review the water resources of Southeastern New Hampshire and make the appropriate recommendations. This resolution was adopted in September 1976 and work was initiated with fiscal 1978 funds.

B. AUTHORITY

Recognizing that some States need Federal assistance in developing water resource plans, particularly in urban and urbanizing areas, on 23 September 1976, the Committee on Public Works and Transportation of the House of Representatives at the request of local interests adopted a Resolution (Appendix A) authorizing a study to determine the advisability of developing various water resources.

C. STUDY OBJECTIVES

The Southeastern New Hampshire Water Resources Study is intended to provide a range of water resource plans which are compatible with comprehensive development goals of the study area.

Meeting the goals and objectives of the water resources study through the planning process will produce:

1. A series of alternative water resources plans, designed to meet long-range resource needs through 2030, from which a choice may be made prior to the completion of the study.

2. A priced and evaluated portion of each of the alternative water resources plans to meet short-range needs, approximately 20 years.

3. A phased early action program for the study region for each alternative short-term water resource plan.

4. If appropriate, recommendations for Congressional authorization of selected elements of the early action programs.

All plans should:

1. Address the specified needs and concerns of the public within the study area.

2. Respond to expressed public desires and preferences.

3. Be flexible to accommodate changing economic, social and environmental patterns and changing technologies.

4. Integrate with and be complementary to other development and management programs.

5. Be fully coordinated with affected public agencies at all levels.

6. Be capable of implementation with respect to financial and institutional capabilities and public consensus.

7. Where appropriate, be certified by applicable State and Federal agencies.

In all instances, planning will be carried out in accordance with the Principles and Standards for Planning Water and Related Land Resources developed by the Water Resources Council under PL 89-90 and approved by the President in 1973.

SECTION II

IDENTIFICATION OF THE STUDY AREA

SECTION II - IDENTIFICATION OF THE STUDY AREA

A. LOCATION AND EXTENT OF THE STUDY AREA

The study area, shown on Plate 1, encompasses 47 communities[1/] and approximately 1000 square miles in the southeastern part of New Hampshire. All New Hampshire communities that fall within the Piscataqua River Basin and the New Hampshire Coastal Area, as well as the communities of Atkinson, Hampstead, Newton, Plaistow, Salem and South Hampton in the Merrimack River Basin are included in the study. Overall, the study area accounts for 9.3 percent of the total land in New Hampshire. It is bounded on the north by the Saco River Basin, on the northeast by the Maine coastal area, on the southeast by the Atlantic Ocean and on the south and west by the Merrimack River Basin. It has a maximum north-south length of about 65 miles and a maximum width of about 35 miles.

The Piscataqua River Basin has a total drainage area of 1,022 square miles, 776 of which are in New Hampshire. The Piscataqua and its largest tributary, the Salmon Falls River, form the boundary between New Hampshire and Maine. The other major rivers within the Piscataqua Basin, shown on Plate 2, are the Bellamy, Cocheco, Lamprey and Exeter.

The coastal area has a total drainage area of 55 square miles. It includes all of the drainage entering the Atlantic Ocean between Odiornes Point in Rye (the south entrance to the Piscataqua River) and the southern end of Seabrook Beach at the Massachusetts state line. The most important waterway is Hampton Harbor. It occupies about half a square mile of the extensive saltwater marsh along the southeastern part of the coast. Hampton Harbor is fed by two small rivers, the Blackwater, entering from the south, and the Hampton, entering from the northwest.

[1/] In December 1978, subsequent to a series of public workshop meetings, Corps and State of New Hampshire representatives met to discuss possible regional water supply systems in southeastern New Hamsphire. They concluded that the communities of Hudson, Pelham and Windham in the Merrimack River Basin should be part of any regional solutions proposed for the Salem-Plaistow area. Therefore, the State of New Hampshire has requested that the Corps of Engineers include these communities in its Southeastern New Hampshire Water Resources Study Area. The Corps will address these three additional communities in addition to the 47 previously authorized.

The text, tables and maps for this Reconnaissance Report were virtually complete and in final form when the request to enlarge the study area was received. Pertinent data for Hudson, Pelham and Windham were then included as footnotes, where needed. A map showing the location of these three communities in relation to the study area is contained in Appendix B.

The remaining 173 square miles are within the Merrimack River Basin. They take in virtually all of Atkinson, Hampstead, Newton, Plaistow, Salem and South Hampton and well over half of Danville, East Kingston and Kingston.

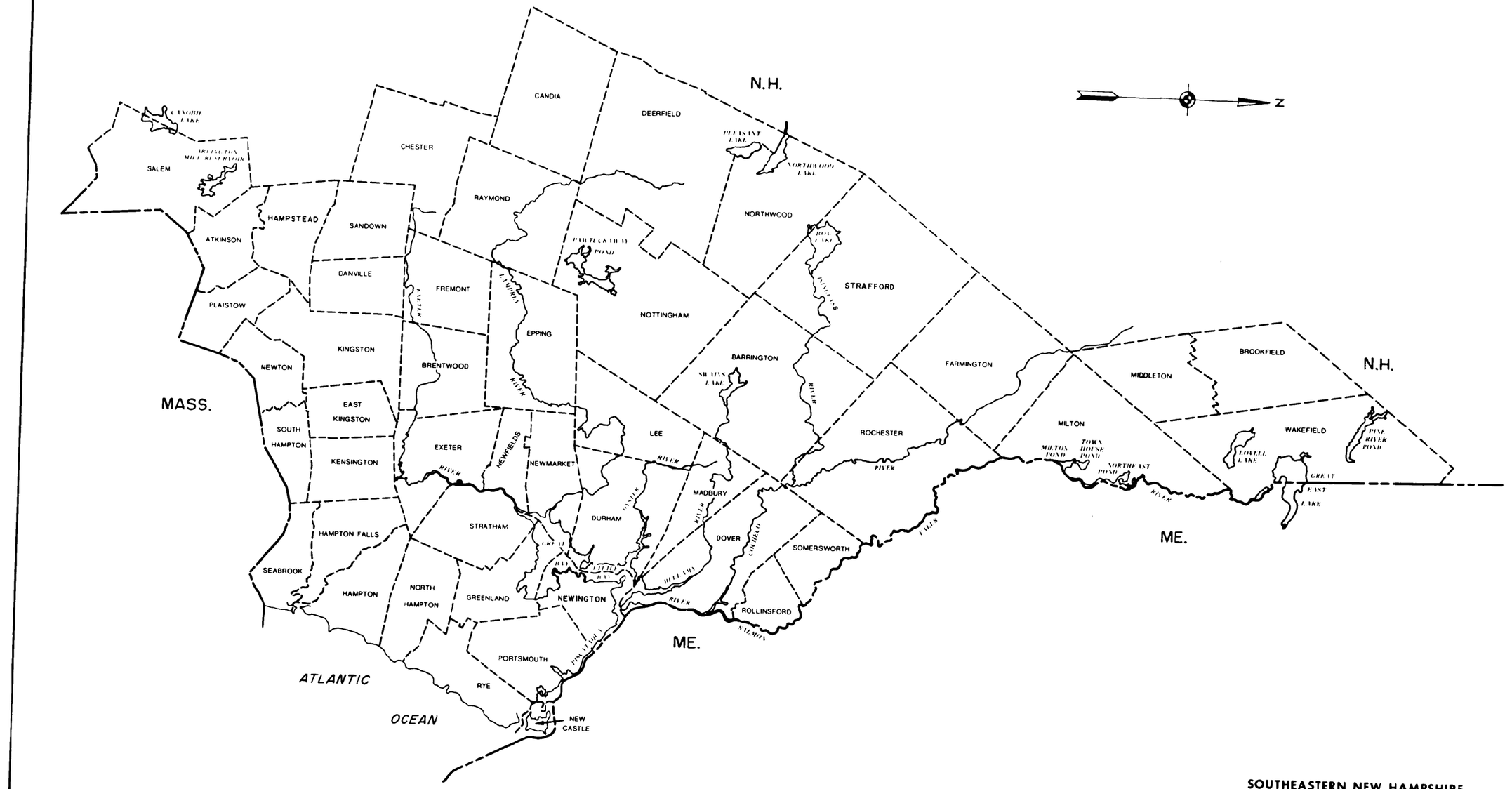
B. GEOLOGY AND TOPOGRAPHY

The topography of the study area varies considerably.

The entire New Hampshire Coastal Area is a flat or gently rolling plain of very low relief with a poorly defined divide separating this drainage area, from adjoining basins. The elevation of the divide is generally less than 60 feet above sea level. A group of drumlins, low hills composed of glacial till, that reach 200 feet or better form the western divide. Apart from the drumlin belt, few other places in the coastal area exceed an elevation of 80 feet. The coastal area is in a mature stage of development; however, the topography is largely a product of marine submergence and glaciation.

The northern portion of the Piscataqua River Basin, in contrast to the coastal area, has high hills and low mountains rising above wide swampy valleys. The valleys here are generally above 500 feet while mountain elevations reach 1,100 feet or more. The remainder of the basin is characterized by rolling to flat lowlands, which blend with the coastal area and have elevations generally less than 100 feet and seldom exceeding 300 feet. Copple Crown Mountain, located on the basin divide in Brookfield, is the highest point in the study area at an elevation of 1,876 feet. Because of this diverse topography, land use patterns vary from forest-town at the head of the Salmon Falls River to an urban strip extending from Rochester to New Castle and down the coast to Seabrook. Most of the study area is farm-forest with town centers generally 4 to 5 miles apart. The main commercial and service trade centers are Portsmouth, Dover, Rochester, Exeter and Hampton. The surficial geology of the basin consists of various deposits and materials characteristic of glaciation and marine submergence. Glacial till blankets the very irregular bedrock surface. Most of the bedrock originally crystallized deep in the earth from magmatic intrusions during the early Paleozoic era. Since that time, geological forces have changed and shaped the land so that the bedrock is near to or outcropping at the surface.

Unconsolidated sediments deposited from ice can be divided into two general classes: till and stratified drift. The glacial till is generally composed of poorly sorted sediments, ranging in size from clay and silt to coarse gravels and some boulders. Till is highly impermeable and commonly called "hard pan." The till in the study area, which overlies the bedrock, is generally less than 15 feet deep. Numerous small lakes, ponds and marshes occupy depressions in the glacial till that blankets the upland valleys. These extensive fresh and saltwater marshes cover nearly one-third of the coastal area's surface.

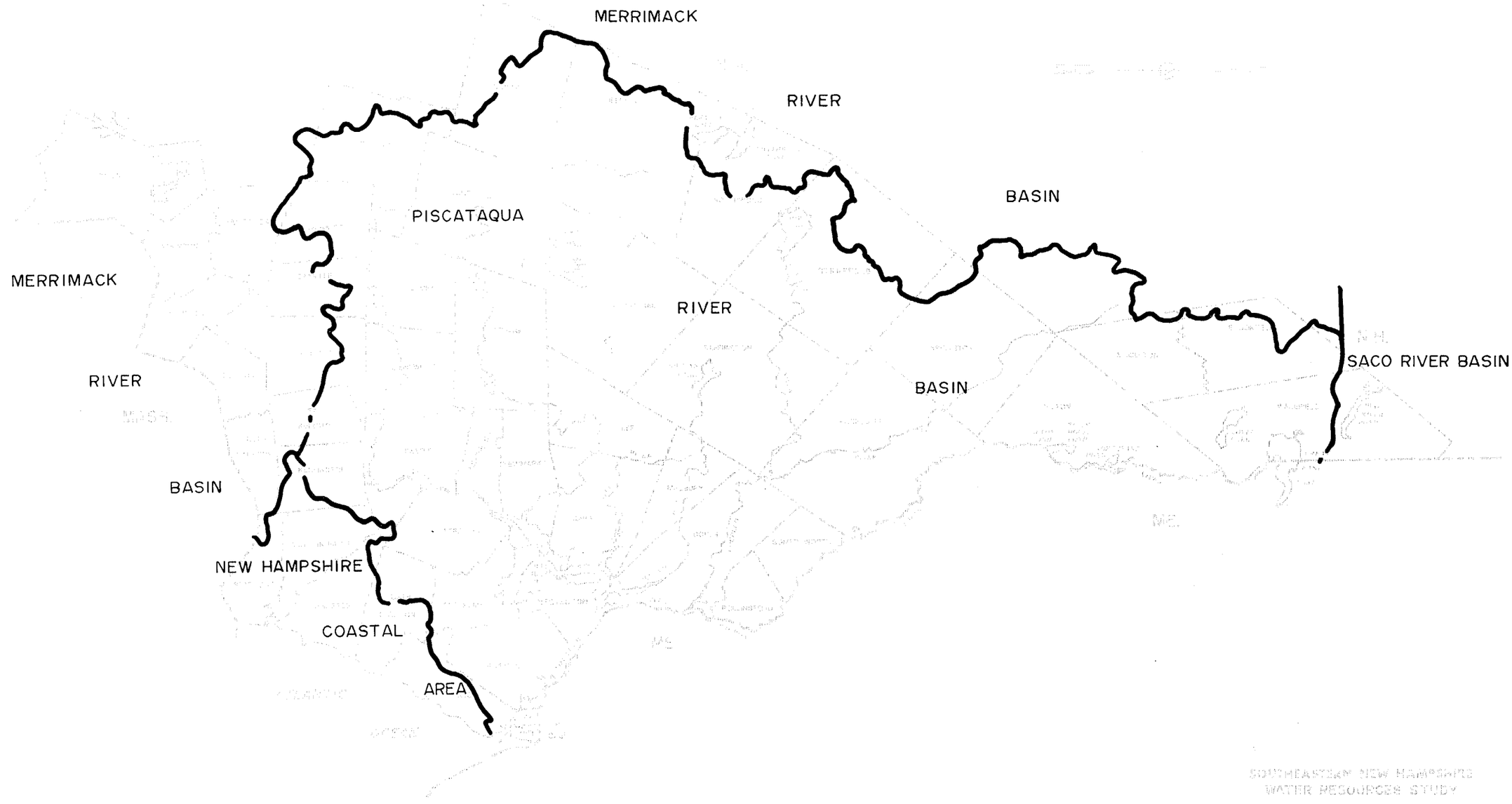


SOUTHEASTERN NEW HAMPSHIRE
WATER RESOURCES STUDY

STUDY AREA

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 1



SOUTHEASTERN NEW HAMPSHIRE
WATER RESOURCES STUDY

MAJOR RIVER BASINS WITHIN THE STUDY AREA

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 2

The stratified drift deposited by melting water is characterized by layering or stratification of medium to well sorted sediments. One kind of stratified drift, termed ice contact drift, is deposited on or next to blocks of stagnant ice. In the southeastern New Hampshire study area ice contact drift generally consists of stratified sands and gravels, ranging in thickness from less than one foot to greater than 190 feet. Another kind of stratified drift is called outwash and is formed from melt water streams flowing over the land in front of the retreating margin of the ice sheet. The generally good degree of sorting of these sediments allows for the high coefficient of permeability characteristic of the medium to coarse grained deposits of stratified sand and gravel. The thickest deposits of this drift are found in the study area's low lying areas and valleys. Farther up in the valley walls the stratified drift deposits thin and give way to exposures of till.

Marine deposits of Pleistocene and more recent sediments are the other unconsolidated sediments in the study area. The Pleistocene deposits that formed as the sea rose and re-advanced over the land in response to glacial melting are similar in lithology, texture and appearance to outwash deposits. These marine deposits are confined to the eastern part of the study area and commonly rest on till or bedrock and occasionally are overlain by, or interbedded with, ice contact and outwash deposits. The marine deposits do not extend more than approximately 20 miles inland or above the 200-foot contour line. The recent deposits consist chiefly of a thin layer of eolian sediments, alluvial material and recent beach deposits.

C. CLIMATE AND HYDROLOGY

The climate of the study area is characterized by four distinct seasons with variable weather. Summers are relatively cool and winters are severe, especially at the inland points. The average annual temperature is about 46°F at the headwaters to the north and about 50°F at points in the coastal area. Average monthly temperatures vary widely throughout the year, from 68° to 73°F in July and August to 18° to 27°F in January and February.

The study area lies in the path of the "prevailing westerlies" and the cyclonic disturbances that cross the country from west or southwest towards the east or northeast. The area is also subjected to occasional violent coastal storms, some of tropical origin, that travel up the Atlantic seaboard. These tropical storms, sometimes known as "nor'easters," are heavily laden with moisture from the ocean; but a great deal of their energy is dissipated before reaching northern New England.

The mean annual precipitation here is 41 inches, and this is distributed fairly uniformly throughout the year at a rate of approximately 3 inches per month. Geographically, the average precipitation

varies from a minimum of 38.2 inches at Massabesic Lake in the southwestern portion of the basin to a maximum of 43.3 inches in the northwestern portion of the Piscataqua River Basin.

Table 1 summarizes precipitation data at selected U.S. Weather Bureau stations. The range between maximum and minimum values of average monthly precipitation at any location is about one or two inches, indicating there are no pronounced dry or wet seasons for the area.

Approximately half or 20 inches of the annual precipitation either flows overland into surface water bodies or percolates through the ground to the water table. The remainder is lost through evapotranspiration. Although the rate of precipitation is fairly uniform throughout the year, the summer is drier than other seasons. This results from the higher rate of evapotranspiration during the warm weather. Most groundwater eventually discharges at the earth's surface into rivers, ponds, springs and other surface water bodies, and groundwater discharge produces the dry weather flows of streams and brooks. It is important to realize the interrelationship and interdependence of these components of the water system.

D. SOCIAL AND ECONOMIC CONDITIONS

1. Population

In 1977, 224,886[2/] persons lived in the southeastern New Hampshire (SENH) study area. Of these, approximately 70 percent live in the Piscataqua River Basin, 20 percent in the Merrimack River Basin and 10 percent in the coastal area. They account for 26 percent of the State's total population, and yet the study area covers only 11 percent

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2/ In 1977 Hudson, Pelham and Windham had a combined population of 25,384. Hudson is the largest of the three towns with a population of 12,595. Pelham and Windham had populations of 8,069 and 4,620, respectively. These towns, like other New Hampshire communities near the Massachusetts border, have been experiencing a rapid rate of population growth. Future population estimates for these three towns are givin in the following tables.

Population Estimates

COMMUNITY	1970	1977	1980	1990	2000	% INCREASE 1970-1977
Hudson	10,638	12,595	19,300	29,370	35,090	18
Pelham	5,408	8,069	8,900	11,770	13,640	49
Windham	3,008	4,720	4,860	6,500	8,600	56
TOTALS	19,054	25,384	33,060	47,640	57,330	

The combined rate of increase in population for all three communities from 1970 to 1977 was 33 percent.

TABLE 1

AVERAGE PRECIPITATION (in inches)*

	Durham	Massabesic Lake (1)	Newburyport Mass. (1)	New Durham**(1)
Period of Record	1941-1970	1941-1970	1941-1970	1951-1960
Elevation m.s.l.	70	250	20	650
January	3.32	2.83	3.48	3.71
February	3.13	2.53	3.32	3.34
March	3.53	2.80	3.68	4.28
April	3.33	2.98	3.46	3.64
May	3.48	3.41	3.64	3.73
June	3.04	3.15	2.83	3.03
July	3.33	3.81	3.46	2.72
August	3.17	3.27	3.13	2.93
September	3.16	3.04	3.56	3.90
October	3.30	3.02	3.29	3.48
November	4.89	4.14	4.98	4.16
December	3.87	3.25	4.19	4.34
Annual	41.55	38.23	43.02	43.26

SNOWFALL**

	Portsmouth	Durham	Haverhill Mass. (1)	Lakeport (1)
Years of Record	6	61	58	21
Elevation (m.s.l.)	40	70	60	560
Average Annual Snowfall (inches)	54	56	53	81

* U.S. Department of Commerce, Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1941-70 - Climatography of the U.S. No. 81 (New England).

** U.S. Department of Commerce, Climatic Summary of the U.S., Supplement for 1951-1960 New England, No. 86.23, Washington 1964.

(1) In Merrimack River Basin.

of the State's total land. General information on the area's population is given in Table 2, and data by community is listed in Table 3. Portsmouth, Salem, Dover and Rochester are the largest communities with 1977 populations in excess of 20,000. Durham, Exeter, Hampton and Somersworth have populations exceeding 9,000. The remaining communities have fewer than 6,000 residents. Seabrook, Hampton and Rye, popular beach resort communities, experience a large influx of temporary residents during the summer months.

In 1970 the study area's population had a density of 196 persons per square mile compared to 57.5 persons nationwide. The New Hampshire Office of Comprehensive Planning's (OCP) recent forecast shows more than a 100-percent increase in this population by 2030 (see Table 3) indicates the magnitude of future demand on the region's water resources.

More realistic estimates of future population will be developed specifically for the study. The need for revised projections has come about because recent projections through 2000 have already been exceeded in some communities.

TABLE 2

STUDY AREA
GENERAL INFORMATION

DESCRIPTION	
Drainage Area (sq. mi)	
New Hampshire Coastal Area	54.8
Piscataqua River Basin	775.8
Merrimack River Basin	173.2
TOTAL	1003.8
% OF STATE AREA	10.7
POPULATION (1000's)	
1977 OCP Population Figures	224.8
% of State Population	26.2
POPULATION DENSITY (persons/sq. mile)	
(Based on 1970 census)	
Study Area	196
Statewide	78
MISCELLANEOUS STATISTICS	
Number of Counties	3
Number of Municipalities	47

POPULATION ESTIMATES

COMMUNITY	1960	1970	1977	1980	1990	2000	2010	2020
Atkinson	1,017	2,291	3,394	5,670	8,910	10,580	11,970	13,250
Barrington	1,036	1,865	3,518	3,250	3,770	4,070	4,360	4,360
Brentwood	1,072	1,468	1,822	2,170	3,880	5,700	7,520	9,420
Brookfield	145	198	345	320	330	340	360	370
Candia	1,490	1,997	2,549	2,470	2,620	2,720	2,820	2,910
Chester	1,053	1,382	1,910	1,950	2,360	2,660	3,000	3,700
Danville	605	924	1,222	1,850	2,930	3,570	4,040	4,440
Deerfield	714	1,178	1,717	1,780	1,950	2,020	2,130	2,220
Dover	19,131	20,850	22,376	24,000	25,320	26,500	28,340	29,570
Durham*	5,504	8,869	9,248	10,390	10,800	11,200	14,240	22,570
East Kingston	574	838	1,046	1,190	2,010	3,020	3,960	4,880
Epping	2,006	2,356	2,701	3,030	4,510	6,110	7,370	8,450
Exeter	7,243	8,892	10,429	10,720	12,460	14,050	14,780	13,150
Farmington	3,287	3,588	4,068	3,600	3,750	4,200	4,320	4,510
Fremont	783	993	1,269	1,500	2,500	4,740	8,060	12,080
Greenland	1,196	1,784	2,000	2,210	4,000	6,170	8,730	11,080
Hampstead	1,261	2,401	3,365	4,620	6,540	7,640	8,950	10,020
Hampton	5,379	8,011	9,717	10,820	16,170	17,730	18,500	19,500
Hampton Falls	885	1,254	1,415	1,500	1,850	1,890	1,950	1,970
Kensington	708	1,044	1,251	1,350	1,920	2,500	3,080	3,700
Kingston	1,672	2,882	3,803	4,640	5,780	6,470	6,510	5,990
Lee	931	1,481	1,748	1,780	2,120	2,300	2,470	2,630
Madbury	556	704	866	880	1,100	1,210	1,320	1,370
Middleton	349	430	482	450	490	500	530	580
Milton	1,418	1,859	2,356	2,450	2,900	3,160	3,310	3,480
New Castle	823	975	954	940	1,140	1,290	1,370	1,340
Newfields	737	843	813	1,000	1,200	1,480	1,880	2,340
Newington	1,045	798	614	1,000	1,750	2,200	3,200	3,580

TABLE 3 - (cont'd)

COMMUNITY	1960	1970	1977	1980	1990	2000	2010	2020	PERCENT CHANGE 1960-1970	PERCENT CHANGE 1970-1977
New Market	3,153	3,361	3,661	3,680	3,800	3,900	4,430	5,780	6.6	8.9
Newton	1,419	1,920	2,895	4,060	5,920	6,960	7,820	8,620	35.3	50.8
North Hampton	1,910	3,259	3,504	4,910	8,000	10,540	13,530	16,000	70.6	7.5
Northwood	1,034	1,526	1,971	1,840	1,870	1,900	1,900	1,930	47.6	29.2
Nottingham	623	925	1,578	1,310	1,590	1,740	1,870	1,970	48.5	70.6
Plaistow	2,915	4,712	5,589	6,550	7,960	8,750	9,350	9,920	61.6	18.6
Portsmouth**	25,833	25,727	28,517	28,430	28,930	29,790	30,540	30,360	-0.4	10.8
Raymond	1,867	3,003	4,614	5,490	7,310	8,640	12,000	16,000	60.8	53.6
Rochester	15,927	17,938	19,979	20,200	20,900	21,500	21,840	22,300	12.6	11.4
Rollinsford	1,935	2,273	2,073	2,100	2,300	2,400	2,560	2,680	17.5	-8.8
Rye	3,244	4,083	4,460	5,230	7,890	10,530	12,660	14,590	25.9	9.2
Salem	9,210	20,142	25,455	31,000	35,500	40,000	40,800	40,430	118.7	26.4
Sandown	366	741	1,596	1,450	1,860	2,100	2,210	2,320	102.5	115.4
Seabrook	2,209	3,053	5,331	6,000	8,100	9,880	9,960	8,140	38.2	74.6
Somersworth	8,529	9,026	10,174	9,450	9,600	9,650	10,150	10,800	5.8	12.7
South Hampton	443	558	694	800	1,200	1,970	2,740	3,620	25.9	24.4
Strafford	722	965	1,417	1,170	1,300	1,370	1,410	1,460	33.6	46.8
Stratham	1,033	1,512	2,022	2,500	4,200	6,910	9,870	12,330	46.4	33.7
Wakefield	1,223	1,420	2,358	1,780	1,830	1,870	1,870	1,910	16.1	66.1
TOTALS	146,285	188,289	224,886	246,040	295,030	336,210	376,550	414,090	28.8	19.4

NOTES: * Includes 4,500 dormitory residents at University of New Hampshire.
** Includes population of Pease Air Force Base (approximately 5,500).

TOTAL STATE	709,264	877,592

2. Economic Development

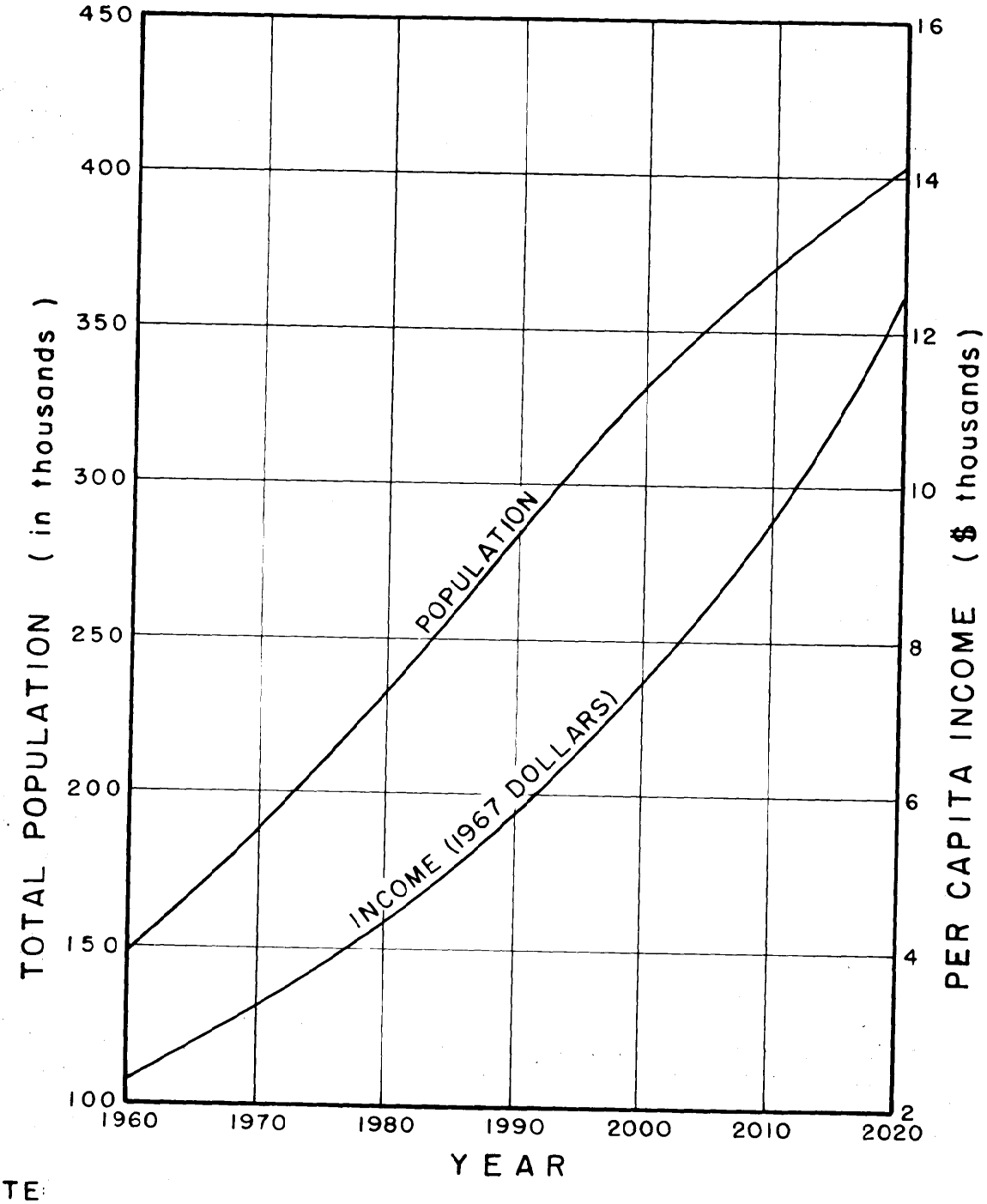
The study area includes Rye, which dates back to 1623 making it the oldest permanent settlement in New Hampshire. Dover, Exeter, Hampton and Portsmouth were also among the earliest towns established. Fishing, lumbering, fur trading, ship building and agriculture were the primary occupations of the early settlers. In the past few decades a variety of industries have been established, especially in the cities of Portsmouth, Dover, Rochester, Somersworth, Exeter and Seabrook. Particularly important are the manufacturing of shoes, electronic products, electrical equipment, automotive accessories, printing machinery and woolen goods.

The economy in the study area, as in New England, generally is characterized by a slowdown in the rate of growth of the manufacturing sector and a growing service base. The region's traditional nondurable goods industries, particularly textiles, leather, food processing and apparel industries, have declined considerably. Employment in this category dropped by 25 percent or 310,000 persons between 1950 and 1970, with about a third of this occurring between 1960 and 1970 but at a slower pace than the national rate. The major durable goods industries are electrical machinery, transportation equipment, fabricated metals and instruments.

The more rapid decline in nondurables and the less rapid rise in durables is one of the major explanations for the region's poor economic record compared to the national average.

The region's rate of employment in service industries, following the overall New England trend, has been rising more rapidly than that of the Nation's. Education, health care, finance and insurance are the largest components.

Table 4 shows the major industries' percentage contributions to the total income of the region and compares them to the national percentages. Per capita income in the study area has consistently been below the national average. Table 5 shows per capita income figures for the Saco subregion which encompasses the study area. Office of Business Economics and Economic Research Services (OBERS) designate Saco, which includes Rockingham, Strafford and Carroll counties in New Hampshire and York County in Maine, a non-Standard Metropolitan Statistical Area (SMSA) water resource sub-area. Plate 3 presents these income trends and population projections for the Southeastern New Hampshire area through the year 2020.



NOTE:

Population data derived from Census and O.C.P. estimates.

Income Data derived from OBERS Projections, 1972 Series "E".

SOUTHEASTERN NEW HAMPSHIRE
WATER RESOURCES STUDY

POPULATION AND INCOME TRENDS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 3

TABLE 4
PERCENT CONTRIBUTION OF REGIONS INDUSTRIES TO TOTAL EARNINGS

SECTOR	1950	1962	1970	1980	1990	2000	2020
Agriculture, Forestry and Fisheries	5.35 (9.11)	1.71 (4.73)	1.39 (3.49)	1.14 (2.54)	0.83 (1.96)	0.65 (1.56)	0.45 (1.10)
Mining	* (1.99)	0.03 (1.26)	0.05 (1.00)	0.07 (0.78)	0.05 (0.62)	0.04 (0.51)	0.03 (0.37)
Contract Construction	4.27 (5.97)	5.75 (5.89)	5.98 (6.13)	6.40 (6.20)	6.53 (6.06)	6.57 (5.89)	6.43 (5.53)
Manufacturing	41.58 (29.01)	29.44 (29.63)	28.33 (27.79)	27.23 (26.21)	25.88 (24.78)	24.71 (23.44)	22.78 (21.39)
Transportation, Communication and Public Utilities	3.93 (8.17)	3.43 (7.36)	3.28 (7.10)	3.46 (7.01)	3.46 (6.90)	3.45 (6.82)	3.37 (6.68)
Wholesale and Retail Trade	14.88 (18.94)	13.95 (17.32)	15.50 (16.55)	16.08 (15.99)	15.78 (15.22)	15.74 (14.69)	15.45 (13.64)
Services	10.29 (11.18)	11.55 (13.49)	13.73 (15.13)	16.73 (17.94)	18.29 (19.94)	19.66 (21.71)	21.87 (24.49)
Finance, Insurance and Real Estate	1.93 (4.23)	2.35 (5.08)	3.08 (5.14)	3.71 (5.79)	4.03 (6.15)	4.30 (6.45)	4.61 (6.81)
Government	17.43 (11.39)	31.76 (15.23)	28.68 (17.66)	25.15 (17.55)	25.10 (18.32)	24.84 (18.94)	24.98 (19.98)

Figures in parentheses are percent of total United States values.

* less than 0.01

The main economic activity along the coast is tourism. A major portion of the residential and commercial development in the coastal communities is influenced by the saltwater recreational activity in the area. The coastline is dotted with motels, restaurants, souvenir shops, amusement areas, marinas and boatyards. In general, the coastal area is open for business from May 15 to September 30 with the intensive business season ranging from July 1 to Labor Day. Of all the coastal towns, Hampton is the major center of recreation and vacation activity.

TABLE 5

PER CAPITA INCOME (1967 dollars)*

	1950	1970	1990	2020
Saco Subregion	1,803	3,045	5,600	12,400
United States	2,046	3,476	6,100	13,200
Saco Relative to U.S.	87%	88%	92%	94%

*OBERS Projections, 1972, Series E.

The OBERS projections indicate that this rising trend will continue in the future and the deviation from the national average will probably decrease.

E. NATURAL AND CULTURAL RESOURCES

As a region with several rivers and a coast, many of the natural and cultural areas in the region are water related. Natural areas consist of resources such as unusual geologic and hydrologic areas and unique flora and fauna. Some of this unique flora and fauna are listed in the Federal Register of threatened and endangered species. Table C-1 (in appendix) lists those species on the Register for the State of New Hampshire. Examples of natural landmarks are the Drowned Forest at Odiorne's Point in Rye and Great Boar's Head in Hampton. Cultural areas include historic structures, sites and districts on local, State and national registers as well as important archeological and educational structures such as museums. These natural and cultural sites not only add to the diversity of the overall environmental but also place certain limitations and requirements on nearby development possibilities and patterns.

New Hampshire is famous for its freshwater game fishing. Many of the larger lakes contain both cold and warm water varieties. Brook, rainbow and lake trout, land-locked salmon, golden trout, bass, pickerel and pike are some of the most popular game fish. Most fishing areas are easily accessible by good roads and have modern boat launching facilities. Ice fishing bob-houses dot the lakes during the winter.

Deer, bear, grouse, woodcock, ducks, pheasant, snowshoe hare, squirrel, raccoon, fox, bobcat and woodchucks are among the hunted animals. The variety of native game birds provide good upland bird and waterfowl shooting. The most important fur bearing animals in New Hampshire are bobcat, beaver, fisher, mink, muskrat and raccoon. Black bear have become more numerous and their range is extending southward in the State. The white-tailed deer attracts more hunters to New Hampshire than any other game animal.

There are 296 species of land and water birds in New Hampshire. In the saltmarshes and tidal areas along the seacoast the herons, egrets, waterfowl, sandpipers, plovers, gulls and terns. The New Hampshire Audubon Society organizes coastal tours as well as trips to the Isles of Shoals where rare land and ocean birds can often be seen.

Programs for listing the animals which are endangered, threatened or of special concern have been developed by the U.S. Fish and Wildlife Service, Department of Interior. The lists are intended to protect the named species and to make the public aware of the general plight of these particular animals. Lists of the endangered species are published in the Federal Register as directed by the Endangered Species Act of 1973.

More information regarding fish and wildlife is included in the Fish and Wildlife Coordination letter (Appendix C).

F. LAND RESOURCES

Over the last decade residential development has consumed land at an increasingly rapid rate. A large number of people residing in towns near the State border work in Massachusetts. Minimum lot size requirements for single family residences range from 6000 square feet to 2 acres in areas with individual sewage disposal. Single family homes account for approximately 73 percent of the dwellings in southeastern New Hampshire. Urban development primarily occurs on agricultural and forest lands.

The availability of high quality agricultural soils is decreasing. According to OBERS 1972, Series E, farm acreage in New Hampshire has declined from about 1,124,000 acres in 1959 to an estimated 490,000 acres in 1977. This rapid conversion of agricultural land threatens long-range local production of food and fiber. Prime agricultural lands are also important to the production of nonfood renewable resources such as forests. Fifty-one percent of the SENH area is covered by forest, mostly second growth on small, privately owned lot sizes that makes commercial harvesting difficult.

1. Water Related Land

Lands adjacent to water are quite valuable. Wetlands, beaches and dunes, groundwater recharge areas, flood plains, agricultural lands and certain unique or cultural areas have limited development capability, however, for a number of reasons. Deciding whether such lands should be developed or conserved involves weighing the social, economic and environmental benefits of development against the benefits of preservation.

One of the most fragile of these is wetlands. The State of New Hampshire now has legislation aimed at protecting wetlands from development that could interfere with their natural functions.

Inland wetlands recycle nutrients, serve as nursery areas, provide habitat for wildlife and serve, in many cases, as natural storage areas for high stream flows, releasing them slowly and modifying downstream flood stages. Alteration of this delicate balance of water, land and vegetation could possibly diminish the ability of wetlands to perform these functions.

Coastal wetlands are thought to enhance water quality because of the flushing action of changing tides. The water quality benefits of inland wetlands are less certain because the decaying vegetation in them increases oxygen demand; however, they may improve water quality in rivers when they gradually release stored floodwaters by providing a more uniform flow.

The coastal beaches, dunes and bluffs along the southeast New Hampshire coast attract large numbers of visitors annually. They also form a line of defense against coastal storms and tidal flooding. Development of those often eroding lands has, in many cases, affected both their popularity and defensive capability.

Potential groundwater as well as surface water sites must be shielded from development. Pollutants can enter the ground at certain sites and filter directly into water supplies. As development encroaches on groundwater recharge areas, the potential for water quality deterioration increases. Protecting these recharge areas, particularly in communities that rely upon groundwater as their source of water, is imperative if the supplies are to be available for future use. Some activities within the SENH area which impact on groundwater quality are highway salting operations, industrial waste discharge, "natural" concentrations of iron and manganese and sanitary landfills.

Tidal rivers and their associated saltwater wetlands are also vulnerable to deterioration and outright destruction from careless land use practices. Tidal rivers and tidal length in the SENH area are the Bellamy (4 miles), the Lamprey (2 miles), the Salmon Falls (3.7 miles) and the Hampton (2 miles). It has been reported that 70 percent

of New England's commercially valuable fish species are either directly or indirectly dependent upon estuaries at various stages of their life cycles. While offshore species may never physically enter estuarine waters, they feed on the many that do so they are tied to estuarine habitats by the food chain. Unfortunately, these species would be threatened by continued loss of coastal habitats and pollution of coastal waters.

Some water-related lands retain their usefulness under limited kinds of development. Flood plains, for example, are capable of supporting certain forms of development, including agriculture and recreation. Such development could be designed to neither impede natural flood flows nor incur substantial damages if flooded. Large-scale development in flood plains within the study area has increased the potential for heavy flood damages.

2. Transportation

Changes in transportation have affected the growth of the State. In 1796, the "turnpike era" began with the charter of the first turnpike, 35 miles long, between Durham and Concord. Better bridges were built, coach routes were established (the first Concord Coach was built in Concord in 1826-27), and hostelries were built. In 1835 railroads began replacing waterway travel and shipping, and in the latter half of the 19th century, the railroad became the key transportation link between cities, towns and farms.

It was in the later 1800's that the railroads were built into the scenic lakes region and through the mountain notches into the north country, opening a vast area of New Hampshire to the travelling public. Affluent residents of the cities of the Northeast were made aware of the beauty of the New Hampshire countryside and became interested in extended vacationing in New Hampshire. The concept of the extended vacation and the "Grand Hotel" came into being throughout New England.

With the simultaneous rise of the automobile and the middle class, vacation patterns changed. The hotels were closed and replaced by motels, camping areas, and second or vacation homes.

In 1950 New Hampshire recognized the need to update highway systems for industrial and recreational development and began modern turnpike construction. Interstate 95 connects Boston, Massachusetts with Portsmouth, New Hampshire and continues north into Maine along the seacoast. The Spaulding Turnpike serves as a major connector between Rochester, New Hampshire and Portsmouth. U.S. Route 3 (Everett Turnpike) State Route 101 is the principal east-west route in the State, connecting Keene with the seacoast. The highway system in New Hampshire allows for fast efficient north-south traffic flow connecting the State with southern New England. The movement from east to west, however, is much more difficult.

The Boston and Maine Railroad Corporation provides freight service but, at present, no passenger service within the State. As with highways, travel from east to west is more difficult as the railroads are laid out to provide service north to south.

Since early colonial days, New Hampshire's development has been closely allied with water transportation, and although its impact on the total New Hampshire economy has been reduced, the City of Portsmouth and the Piscataqua River provide important commercial port facilities. Portsmouth is the only natural deep water harbor between Boston, Massachusetts and Portland, Maine. Portsmouth Harbor and the mouth of the Piscataqua River combine to offer tidewater sites on seven miles of ice-free navigable waters.

G. DESCRIPTION OF EXISTING PROBLEMS

1. Overview

The following paragraphs describe problems and needs currently existing within the region that will be examined in this study. The problems have been identified during discussions with Federal, State and regional planning agency officials, from data developed for the Southeast New Hampshire Water Supply Study, from a preliminary planning overview done with the State, and from public workshops conducted as part of the study's public involvement program. The items discussed are not considered to be all inclusive of the problems and needs which exist in the study area, and others will undoubtedly emerge as the study progresses.

The major problems here concern water supply and water quality. The main focus of this water resources study will be on water supply. Water quality studies are being handled under the provisions of Section 208 of PL 92-500, the Clean Water Act. In southeastern New Hampshire two regional planning agencies, the Strafford-Rockingham Regional Council and the Lakes Region Planning Commission, have been designated by EPA to conduct 208 planning within their jurisdiction. Strafford-Rockingham Regional Council's designated 208 area is only that part of its region covered by the Southern Rockingham Regional District Commission. The remainder of 208 planning in southeastern New Hampshire is being done by the State through the Water Supply and Pollution Control Commission. Results of the 208 program will be evaluated and incorporated into our study where applicable. This should produce a more comprehensive water resource plan.

The other water resource components to be addressed in the study are flood damage reduction, navigation and recreation.

2. Water Supply

Of the 47 municipalities[3/] within the southeastern New Hampshire study area 22 are now served, at least in part, by municipal water systems (see Plate 4). With the population explosion that is expected to continue here, many of the 25 communities not served will have to initiate a public water supply system within the study's time frame.

Average daily demand on the public water systems in 1977 was 17 million gallons per day (mgd). The current safe yield of the system is 31 mgd. By the year 2030 the SENH area is expected to have a net deficit of 20 mgd.[4/] These figures are misleading, however, in that they represent the region as a whole and do not reflect the varying conditions wtihin the individual communities. In order to develop comprehensvive water supply alternatives the present capabilities and future requirements of each community will have to be evaluated. Subregional alternatives will then be formulated so that each community can develop in such a way that the region's water resources will be utilized to their full extent.

Initial estimates indicate about an overall water supply deficit of 10 mgd as early as 2000. Communities identified to date as requiring additional supplies by 2000 are listed in Table 6.

TABLE 6

ESTIMATED WATER SUPPLY DEFICITS
BY THE YEAR 2000 (mgd)

COMMUNITY	DEFICIT (Ave Day)
Atkinson	0.87
Brentwood	0.44
Danville	0.28
Dover	0.91
East Kingston	0.24
Epping	0.30
Fremont	0.36
Hampstead	0.62

[3/] Hudson is the only one of the three recently included communities with a municipal water supply system. Hudson's average day demand is .5 mgd on a system with an estimated safe yield of 1.75 mgd. By 1990 the town will be unable to meet its projected average day demand of 2.8 mgd unless additional sources are developed.

[4/] Projections of demands and deficits throughout the report are based on a 1976 water supply overview, except where more accurate figures were obtained in visits to the water companies. During the second phase of the study these demand figures as well as the population figures will be revised to reflect any recent changes which might have occurred.

TABLE 6 (cont'd)

COMMUNITY	DEFICIT (Ave Day)
Kingston	0.49
Newton	0.59
Plaistow	0.73
Portsmouth	0.38
Raymond	0.14
Rollinsford	0.08
Salem	2.62
Somersworth	0.15
South Hampton	0.15
Stratham	0.55
TOTAL	10.03

The four largest communities, Portsmouth, Dover, Exeter and Salem, account for 40 percent of the study area's population and 45 percent of the publicly supplied water. With the exception of Exeter these larger communities can barely meet present needs.

The city of Portsmouth's water supply system is the largest in the SENH area. It serves the developed part of the city as well as portions of Newington, Greenland, Rye and New Castle. Its main source of water is the Bellamy Reservoir in Madbury. A series of wells, together with the reservoir, provide a total supply of 6.0 mgd. The existing average day demand on the system is 4.2, and it is expected to reach 8 mgd by 2020.

Salem, the second largest community in the study area, has the most immediate need of additional water supplies. The town's population more than doubled in the last 10 years. With this rapid rate of development the average daily demand rose to 1.6 mgd by 1977, approaching the 1.8 mgd capacity of Canobie Lake, the water supply source. The 1980 average day demand for Salem is expected to be 3.1 mgd, resulting in a 1.5 mgd deficit to the present system.

Epping and Raymond face a situation similar to that of Salem's, although not of the same magnitude. They will be unable to meet their average daily demands as early as 1980. Their municipal wells yield .14 and .18 mgd respectively, and by 1980 the two towns will have a combined deficit of approximately .1 mgd. Epping added a second well in an attempt to augment its supply, but the well subsequently failed. Earlier investigations have indicated there is a potential groundwater source in Epping that is capable of supplying all future demands.

SOUTHEASTERN NEW HAMPSHIRE
WATER RESOURCES STUDY

TOWNS WITH EXISTING PUBLIC WATER SUPPLIES

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 4

The community of Dover will require more water by 1990 if the population growth there continues its current trend. The average day demand of 2.6 mgd is expected to reach 3.6 mgd by 1990. Its water supply system, which consists of a number of gravel packed wells, has a combined safe yield of 3.2 mgd. This system also serves a very small part of Rollinsford and Madbury. During the summer of 1977 the daily demand became great enough to require a ban on water for the first time in 18 years.

Seabrook and Hampton are able to meet their projected average day demands through 2010 with their current water supply systems. By 1980, however, neither community will be able to meet maximum day demands. They both experience a large influx of summer visitors who place heavy daily demands on the systems. Unless additional supplies are developed, the combined maximum day deficit for the two communities will be about 3.2 mgd. North Hampton and part of Rye are also served by Hampton's municipal water system.

Durham has a municipal surface supply of 1.7 mgd, two-thirds of which is used by the University of New Hampshire. Average day demand, now .77 mgd, is projected to reach 2.2 mgd by 2020.

Newfields, a small community of approximately 800 residents, has an average day demand of .05 mgd. Its municipal well system has a safe yield of .14, mgd; however, the average day demand is projected to reach .18 mgd by 2010.

The neighboring communities of Rochester, Somersworth and Rollinsford all have a similar water supply situation -- namely, municipal water supplies capable of meeting only short-range needs. Rochester, largest of the three communities, has a surface water supply system with a safe yield of 4.0 mgd. Its average day demand is expected to be 4.4 mgd by 2020. Somersworth has a combined surface and groundwater supply system with a safe yield of 1.93 mgd. With this present system Somersworth will need additional water by the year 2000. Additional supplies are available in Somersworth, but their development would require expansion of the existing treatment plant. By 1990 the average day demand for Rollinsford will exceed the safe yield of existing wells.

Exeter's water supply system can meet its projected average day demands throughout the time frame of the study. However, treatment facilities will have to be expanded to meet maximum day demands beyond 1990 because the present supply is limited by a 2.4 mgd capacity water treatment plant. Total safe yield of the municipal system is 2.75 mgd since a .35 mgd well not requiring treatment also feeds the system. With expansion of the treatment plant to its maximum design

Regional sand and gravel operations are another source of nonpoint source pollution. The pollutants are silt and clay, which cause turbidity and color in the streams.

Sediment carried by runoff water to streams and surface water is the major pollutant resulting from forestry activities. Poor forest management and careless logging operations cause most of this problem.

Although surface waters have suffered from these practices, groundwater quality in the study area is good. It is generally pleasing in appearance with most of it clear and colorless and containing very little suspended matter. Analyses show that chemical constituents and properties of groundwater are usually well under or within accepted health limits. Some chemical analyses of groundwater in sand and gravel aquifers in southeastern New Hampshire follow (EPA-1974):

NUMBER OF SAMPLES	CONSTITUENT OR PROPERTY	MEAN VALUE (concentration in mg/l)
30	Iron (Fe)	00.035
52	Chloride (Cl)	09.500
24	Sulfate (SO_4)	12.500
35	Hardness (as Ca CO_3)	43.000
24	Total dissolved solids	78.500
52	pH	06.800

They show the water to be free from contaminants, low in dissolved solids and soft (less than 60 mg/l of hardness).

While overall groundwater quality is very good, there are local problems. Iron and manganese may occur in concentrations greater than EPA's recommended limits for drinking water -- 0.3 and 0.05 mg/l, respectively. There have been cases recorded of wells being forced to shut down because of high concentrations of iron and manganese. The water is weakly acidic with a pH of less than 7.0, and problems with corrosion of metal plumbing systems have occurred.

Urbanization has also affected groundwater quality in some localities. Degradation of water may occur near sanitary landfills, major highways, large clusters of septic tanks and croplands. Nearby polluted surface waters can contaminate groundwater through induced infiltration.

4. Flood Damage Reduction

Flooding can damage and destroy property, displace families, create serious health hazards, disrupt business and communications and, most seriously, cause loss of life. Increased development on flood plains will intensify potential for these damages.

There is one existing major Federally constructed flood control project in the study area, a local protection project in Farmington consisting of a river channel improvement, dikes and a floodwall along more than two miles of the Cocheco River. In addition, there are two shoreline protection projects, one at Hampton Beach and the other at Wallis Sands State Beach. These two projects consisted of beach restoration and construction of protective groins.

The problem of flood control has been addressed under several authorities in the North Atlantic Regional Water Resources Study (NAR) and the New England-New York Inter-Agency Committee Report (NENYIAC).

Thirty-two of the communities in the SENH study area are being investigated in the Department of Housing and Urban Development's (HUD) Federal Flood Insurance Administration Program (FIA). Of this total two are in the regular program, sixteen are in process and the remaining fourteen are to be completed by 1983.

FIA flood hazard boundary maps delineating the 100-year flood plain have been prepared for the communities to be studied. These maps and previous reports such as the Corps of Engineer's Flood Plain Information Reports will be examined to determine if there are any areas with a significant potential for flood losses. If such areas are identified alternatives will be developed to reduce the potential for loss.

The study area is subject to two distinctly different types of flooding, riverine and coastal. However, flooding was not among the subjects brought up for discussion at the three public workshop meetings held in September 1978.

Based on information gathered to date, the study area does not have a history of severe flooding so study efforts in the area of flood damage reduction are expected to be small.

5. Navigation

Portsmouth Harbor is the only major port serving commercial traffic in the study area. In 1975 nearly 3 million tons of waterborne cargo passed through this port. There is also small craft pleasure boating on the Exeter and Lamprey Rivers, Great and Little Bays and Little Rye and Hampton Harbors. Dredging of some existing channels and widening of turning basins in some of the waterways might be necessary to better open the area to small boat traffic.

Periodic maintenance dredging of Portsmouth Harbor will be done as the need arises. A feasibility study for improving the existing 35-foot Piscataqua River-Portsmouth Harbor channel by widening at the bends and increasing the areas of the turning basins is being conducted by the Corps of Engineers.

Town officials of Exeter requested the Corps look into the possibility of redredging the Federal channel in the Exeter River from the Ox Bow to the town of Exeter for the purpose of recreational boating. This issue will be addressed under the Corps maintenance program for existing Federal projects.

There were no additional navigation needs or problems identified during the reconnaissance phase.

6. Recreation

Southeastern New Hampshire offers a wide range of scenery: spectacular fall foliage, clean, sandy beaches, beautiful lakes and picturesque countryside. These qualities attract both residents and nonresidents. Many recreational activities, especially in the coastal area, involve such water-related pastimes as swimming, boating, canoeing and fishing.

All water bodies larger than 10 acres in New Hamsphire are public property held in trust for public use. Public access to these bodies of water, however, is sometimes impeded because of private development along the shorelines.

The demand for water-related recreation facilities is increasing as the population of the SENH area increases. New recreational facilities of all types will be required to satisfy the public's needs and wishes.

The development of water-oriented recreational plans will not be a task of this study. The Statewide Comprehensive Outdoor Recreation Plans (SCORP) do an adequate job of this. Various regional planning agencies have also included recreation in their land use planning for their service areas. These plans address themselves to preservation of open space for recreation and protection of flood plains by using them as recreation areas.

SECTION III

STUDY MANAGEMENT

SECTION III - STUDY MANAGEMENT

A. STUDY PLANNING OBJECTIVES

1. General

The basic objective of the study is to develop plans which not only provide solutions for specific water resources problems but also offer the potential to assist in the solution of related problems. In this regard, Corps water resource planning is consistent with national objectives.

2. National Objectives

Water resources planning undertaken by Federal agencies is directed by the Principles and Standards for Planning Water and Related Land Resources of the U.S. Water Resources Council. These principles provide the basis for Federal participation with river basin commissions, State agencies and other concerned groups in developing regional plans for use of water and related land resources to meet short and long-term needs. Regional plans will, therefore, be developed with the objectives of enhancing national economic development (NED) and national environmental quality (EQ). Economic development is enhanced by increasing the value of the Nation's output of goods and services and by improving national economic efficiency. The quality of the environment is enhanced by the improved management, conservation, preservation and creation or restoration of certain natural and cultural resources and ecological systems. The study will focus on these overall objectives as well as evaluate the effects of any plans on regional development and social well-being.

Each alternative water resource plan developed will address the following needs:

- Water quality.
- An adequate source of municipal and industrial water supply .
- Protection against flooding and the wise use of flood plains.
- Compliance with recreational goals of the region.
- Navigation requirements.

3. Specific Planning Objectives

Specific planning objectives have evolved during the preliminary assessment of water resources issues. The objectives are based on issues identified in the Corps of Engineers July 1976 report, "Southeast New Hampshire Water Supply Study," meetings with State and regional officials and a series of public workshops held in September 1978. The objectives are listed in the following section.

B. CURRENT PLANNING AND RELATED DATA

There are a number of Federal, State, regional and local agencies involved in water resources planning efforts for southeastern New Hampshire. A large data base associated with planning in the study area has been compiled. The collected data from both ongoing and completed studies and reports will be utilized during this study to avoid duplication of time and effort. There will also be additional information gathered and correlated for this study. Some of the more recently completed planning reports pertinent to this study are summarized in the following paragraphs:

Piscataqua River and Coastal New Hampshire Basins, Water Quality Management Plan

This report, prepared by the New Hampshire Water Supply and Pollution Control Commission, was authorized under the Federal Water Pollution Control Acts Amendments of 1972, P.L. 92-500, Section 303 (e) and the New Hampshire Continuing Planning Process. The purpose of this study was to determine a course of action to restore and/or maintain the chemical, physical and biological integrity of the waters of the Piscataqua River and Coastal New Hampshire Basins.

North Atlantic Regional Water Resources (NAR) Study

Published in June 1972 by the Army Corps of Engineers, this study examined a wide variety of water and related land resources, needs and desires in formulating a broad and coordinated program to guide future resource development and management in the North Atlantic Region. This Level A study was authorized by the 1965 Water Resources Planning Act (P.L. 89-80) and the 1965 Flood Control Act (P.L. 89-298) and was carried out under guidelines set by the Water Resources Council.

The recommended program and alternatives developed for the North Atlantic Region were prepared under the direction of the NAR Study Coordinating Committee, a partnership of resource planners who represent some 25 Federal, regional and State agencies. The study area consisted of 13 northeastern states including all of New England. The NAR study report presents the recommended program and the alternatives as a framework for future action based on a planning period running through 2020, with bench mark planning years of 1980 and 2000. The NAR study includes southeastern New Hampshire in part of the region identified as Area 6 and a small part of Area 7.

Southeast New Hampshire Water Resources Study. Comparison and Evaluation of Earlier Identified Reservoir Sites

Published in April 1978 by the Army Corps of Engineers, the purpose of this investigation was to review sites proposed for surface supply reservoirs. Each site was evaluated on the basis of engineering, environmental, economic and social aspects. The information obtained and developed from this investigation is to be used in the decision process regarding short and long range planning.

Northeastern United States Water Supply Study, Merrimack River Basin Water Supply Study

The studies presented in this report, issued by the Army Corps of Engineers in January 1977, are directed toward developing a plan for utilizing the Merrimack River as a water supply source for eastern Massachusetts and possibly southeastern New Hampshire. All reasonable alternative plans to solve the region's future water supply problems were considered and several plans studied in detail including economic, environmental and socio-economic effects. All of the plans were also evaluated to determine their compatability with the development of a regional plan.

New Hampshire Water Resources Board Report on Metropolitan Water Supply for Seacoast Area

This study, completed in October 1960 by Camp, Dresser and McKee, addressed the present and future water supply problems of those communities within a radius of approximately twelve miles of the Bellamy Water Treatment Plant in Madbury. The report identified those communities with a need for additional supplies and evaluated the feasibility of developing a Metropolitan System. In addition to expansion of the Madbury Plant, the final recommendation proposed development of the Isinglass Reservoir.

Public Water Supply Study

Anderson-Nichols conducted this two-phase study. Phase one was completed in 1969 and phase two, a more detailed report utilizing data from phase one, was completed in 1972. The recommendations in both these reports called for a diversion from the Merrimack River and Lake Winnipesaukee as additional water supply sources. However, figures used for population projections in these reports were felt to be too high thus the future water demands were deemed a little too high.

Land Use Plan - A Citizen's Synopsis

Strafford Rockingham Regional Council, 1977.

Southern Strafford Region - An Environmental Planning Study

Stafford Rockingham Regional Planning Commission, 1976.

Environmental Impact Statement - Southern Rockingham Water Quality Management Study

Southern Rockingham Regional Planning District Commission

C. STUDY MANAGEMENT

The reconnaissance report, which is subject to revision as study plans are refined or modified, is intended to serve as an overall management guide. Its objective is to facilitate a sound and orderly process leading to plan selection. All parties responsible for the study will insure that the various tasks and schedules outlined will be strictly adhered to.

1. Study Responsibility

The Division Engineer, New England Division, U.S. Army Corps of Engineers, will have overall responsibility for the conduct and management of the study. The day-to-day management will be the responsibility of the study manager who, in turn, will report to the Chief, Urban Studies Section, Basin Management Branch, Planning Division. The study team itself will comprise of a multidisciplinary unit within the Urban Studies Section, augmented by expertise of others in the Division organization.

Study progress will be monitored by the study manager, who will be responsible for comparing progress to time, cost and work effort schedules outlined in the reconnaissance report. Modifications to the report will be the responsibility of the Corps of Engineers.

2. Management of Specific Objectives

Management of the specific planning objectives to be carried out in this study is outlined by work items in this section.

a. Water Supply

- Conduct a detailed assessment of the adequacy and suitability (quality) of available water supply resources relative to the short-range (2000) and the long-range (2030) needs of communities within the study area.

- Develop a regional management plan, including an identification and evaluation of both structural and nonstructural measures that could be used to satisfy future municipal and industrial water requirements.

- Identify additional sources of supply that may be feasible due to water quality management developed by the Section 208 planning program.

- Evaluate existing legal authorities and current agreements concerning the allocation of the water resources. When coupled with the above tasks, this will insure an adequate supply of safe drinking water.

b. Flood Damage Reduction

- Review work performed within the New Hampshire Office of State Planning (OSP).

- Incorporate results of OSP work into this study where applicable.

- Review Flood Insurance and Flood Plain Information reports along with flood profiles to assess potential flood losses.

c. Navigation

- Review and assess existing commercial and recreational boat facilities and the demand at Portsmouth Harbor, the Exeter and Lamprey Rivers, Great and Little Bays and Little and Hampton Harbors.

- Develop regional plans for recreational boating facilities and navigational improvements, if the need exists.

d. Recreation

- Review the New Hampshire Statewide Comprehensive Outdoor Recreation Plans (SCORP) and other recreational plans devised by various regional planning agencies.

- Incorporate any applicable recommendations into water resource plans developed in this study.

3. Coordination

Continuous coordination will be maintained throughout the study with representatives of various institutions having a significant interest in water resources management in the study area, particularly the State Water Resources Board which has been designated by the Governor of New Hampshire as the State Coordinating Agency.

Following is a list of institutions that have a significant interest in water resources management in the study area:

Ashuelot River in Keene and Swanzey.

a. Federal Agencies

U.S. Geological Survey, Water Resources Division (U.S.G.S.) - The U.S. Geological Survey agency surveys, investigates and researches the topography, geology and mineral and water resources of the United States. It is responsible for coordinating all Federally collected data having to do with water resources. To facilitate this task, the U.S.G.S. maintains catalogs and maps of water-related information which is useful in planning.

U.S. Department of Agriculture, Soil Conservation Service (SCS) - The Soil Conservation Service provides technical assistance in the development, application and maintenance of soil and water conservation plans through local soil conservation districts. The agency also is authorized to assist local governments with planning and financing watershed conservation projects and other flood prevention measures. These programs promote the conservation, development and use of water and the prevention of soil erosion.

U.S. Environmental Protection Agency (EPA) - The Environmental Protection Agency is responsible for the control of air and water pollution, drinking water quality, solid wastes, pesticides, environmental radiation and noise. Through legislation contained in PL 92-500, the agency establishes deadlines for cleaner waters, schedules of user charges, areawide planning and provides funding and enforcement powers to achieve the elimination of discharge of pollutants into the Nation's waters. Congress has authorized EPA to provide grants to States for research and development, manpower training, water quality planning, monitoring and enforcement.

U.S. Department of Housing and Urban Development (HUD) - Under the provisions of Section 701 of the National Housing Act of 1954, as amended, this agency works with the State and local governments in planning and developing solutions to housing problems, mass transportation, water supply, water quality management, runoff control and related problems. The HUD National Flood Insurance Administration provides Federal assistance and subsidy to individuals wishing to insure themselves against flood loss.

U.S. Fish and Wildlife Service - The primary goal of this agency is conservation and enhancement of fish and wildlife resources. Major conservation activities include the acquisition and management of National Wildlife Refuges, operation of fish breeding, distribtuion and restoration programs, protection of critical habitats, management of game birds, enforcement of Federal laws protecting wildlife and consultation with other Federal agencies engaged in water development projects.

U.S. Bureau of Outdoor Recreation (BOR) - Within the Federal Government this is the central agency concerned with outdoor recreation, and it is responsible for the preparation of long-range, nationwide, continuing outdoor recreation plans. The Bureau is authorized to provide grants for planning, acquisition, and development of recreation areas and facilities.

U.S. Department of Energy (DOE) - The Department of Energy was formed to take charge of national energy policy, regulation and research. Established by PL 95-91, the agency is responsible for 1) providing a mechanism through which a coordinated national energy policy can be formulated and implemented to deal with both short and long-term energy problems, 2) creating and implementing a comprehensive energy conservation strategy, and 3) formulating an energy research and development program placing major emphasis on development and commercial use of solar, geothermal, recycling and other technologies using renewable energy resources to provide an adequate and reliable supply of energy at the lowest reasonable cost.

b. Interstate Agencies

New England Interstate Water Pollution Control Commission NEIWPCC - The NEIWPCC, authorized in 1947, is a compact consisting of the six New England States and the adjacent State of New York. Its primary function is the achievement of water pollution abatement and control in the region's interstate waters. The Commission's interests include water quality management, survey and investigations, water classification and coordination of State water pollution control programs as they pertain to interstate waters.

New England River Basins Commission (NERBC) - The Commission is a Federal-State planning organization established in the Water Resources Planning Act of 1965. Its membership is composed of the six New England states and New York, ten Federal agencies and six interstate regional agencies with responsibilities in water pollution and flood control. NERBC has three statutory responsibilities: coordinating water and related land resources plans throughout the region; preparing and updating plans for managing the region's water and related land resources, recommending priorities for collection of natural resource data, solutions to resource management problems and implementation schedules.

c. State Agencies

Water Resources Board (WRB) - The Water Resources Board was formed, according to RSA 481:1, because of the ". . . Statewide need for the conservation and distribution of water and the regulation of the

flow of rivers and streams . . . and the special public need for dams and reservoirs to lessen damages resulting from floods and to promote the State's industrial and economic welfare, by enhancing the present and potential water power along the rivers and streams . . ."

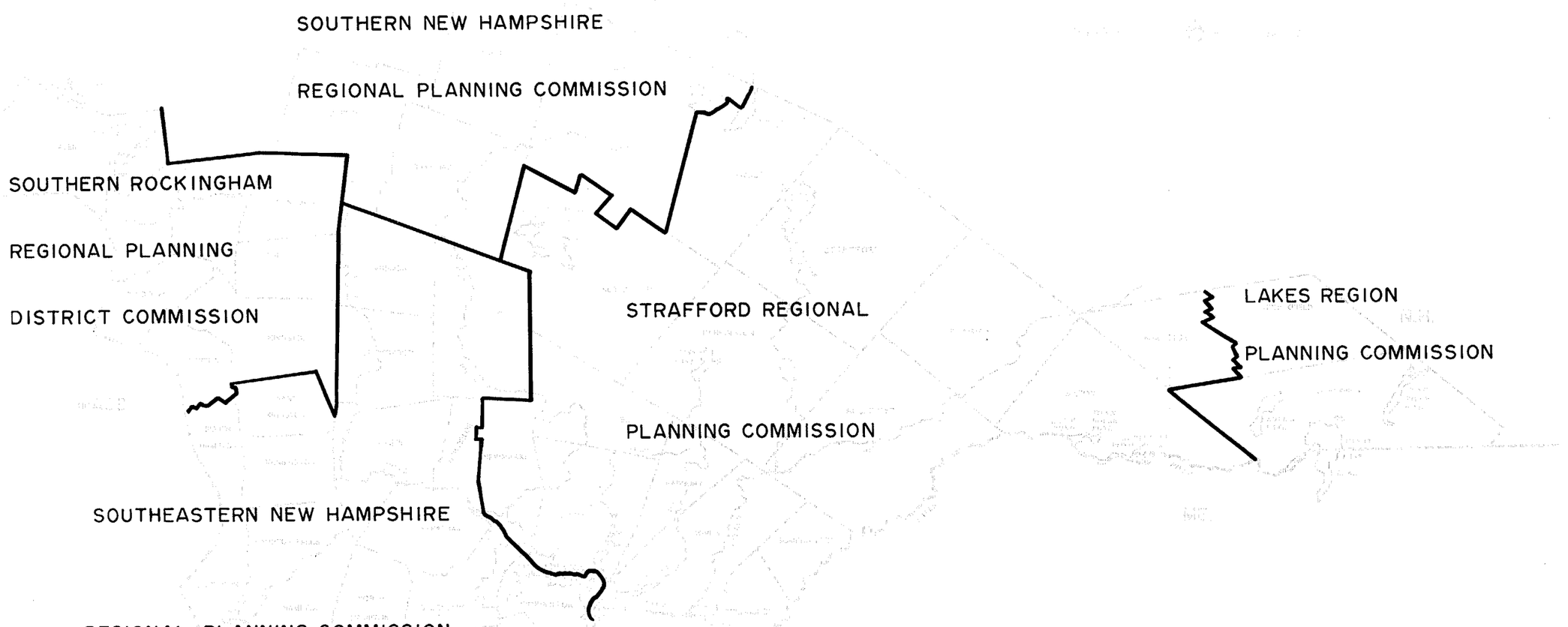
Water Supply and Pollution Control Commission (WSPCC) - The Commission regulates public water supplies of the State, sewage disposal and treatment, and water pollution control. Services include water quality testing, consultation on all aspects of water supply and liaison for Federal assistance with water pollution abatement facilities and treatment plants. The WSPCC issues effluent discharge permits, reviews plans for dredging and provides the rules and regulations relative to individual sewage disposal systems.

Office of Comprehensive Planning (OCP) - The office is concerned with both statewide and substate planning. At the level of State planning, Federal and State funds are used to develop land and water use transportation, housing and recreation plans and to update and expand the socio-economic data base for New Hampshire.

Substate planning encompases local planning assistance regarding the National Flood Insurance Program and flood plain management, the establishment of historic districts and conservation commissions, the procedures for adopting planning ordinances and regulations, and general technical advice on community planning. Coordination, support and administration of State and Federal grants for regional planning agencies are also important functions. It has initiated a Coastal Zone Management Program for sound management of coastal area resources.

Regional Planning Agencies (RPA) - As its name suggests, RPA is responsible for adopting a regional approach to all aspects of local planning and development. It engages in comprehensive planning in coordination with the State. Regional planning agencies sponsor informational meetings and workshops for Planning Board and Conservation Commission members and interested citizens on a variety of topics including soil surveys, natural resource inventories and participation in the National Flood Insurance Program.

The Strafford-Rockingham Regional Council (SRRC) has jurisdiction over a major portion of the study area. SRRC is affiliated with and oversees the activities of and funding for the Southeastern New Hampshire Regional Planning Commission (SENHRPC), the Southern Rockingham Regional Planning District Commission (SRRPDC) and the Strafford Regional Planning Commission. (See Plate 5.) Because of their experience and familiarity with the study area, the Corps contracted with SRRC to manage Phase I of the Public Participation Program. That series of workshops helped identify problems in the study area.



SOUTHEASTERN NEW HAMPSHIRE
WATER RESOURCES STUDY

REGIONAL PLANNING AGENCIES

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 5

The communities of Brookfield and Wakefield come under the jurisdiction of the Lakes Region Planning Commission. Candia, Chester, Deerfield and Raymond are under the Southern New Hampshire Planning Commission's authority.

4. Institutional Arrangements

a. General

This water resources study is intended to develop comprehensive water resource plans that are both compatible with the resource development goals of the study area and capable of implementation with respect to financial and institutional capabilities within the area. To insure each alternative is indeed implementable, a thorough analysis of the institutional structure must be made.

By definition, an "institution" is a process or organization that is highly structured, systematized and stable. Institutional structures may be organizations such as planning agencies, water commissions, sewer boards or special interest groups; or they may be formalized practices or procedures such as home rule, tax structures or financial obligations. "Institutional analysis" is a process whereby institutions directly or indirectly related to water resources planning and management are identified and their capability to implement alternative plans is assessed.

b. Analysis Procedures

Institutional analysis parallels the overall planning process, moving from broad collection to detailed arrangements for implementing the water resources alternatives.

Specific tasks to be undertaken in the institutional analysis are:

(1) Establishment of an institutional data base, including an inventory of existing agencies and agency types.

(2) Analysis and evaluation of institutional capabilities to implement the water resources plans developed in the study to include organizational information, scope of operation, financial strength and capacity, jurisdiction and relationship with public interest groups and other agencies.

(3) Development, presentation, analysis and evaluation of alternative institutional arrangements and implementation strategies.

Overall, institutional analysis will focus on the organizational and financial analysis of government agencies, primarily at the local level, as water resources management in the study is predominantly a local government responsibility. Assessment of existing institutional capability will be followed by recommendations for modifications to make such institutions more effective. Study emphasis will be placed on continuance or modification of existing institutions rather than the creation of new ones.

c. Existing Institutions and Trends

Although Federal and interstate agencies perform various functions, it is State and local governments which share the major responsibility for water resources planning, regulation, technical and financial assistance, and policy development. The more prominent interstate bodies are concerned with all aspects of water resources management from an overall regional perspective, while State and local government agencies provide the framework for existing institutional structures.

5. Study Sequence

The study will be conducted in three distinct stages. Planning will be conducted by carrying out the four functional planning tasks during each of the three stages of plan development. These tasks are problem identification, formulation of alternatives, impact assessment and evaluation.

a. Stage 1 - Reconnaissance Report

During this initial stage, the four planning tasks are performed at a preliminary level of detail to define the scope and character of the study, to determine whether additional study is warranted and to guide subsequent planning. However, emphasis will be on identifying the range of issues related to resource management in the study area. The effort will generally involve analyzing a wide range of available data and making an initial analysis of water and related land resources management problems and how they could be solved.

b. Stage 2 - Development of Intermediate Plans

Stage 2 planning will more thoroughly analyze the problems and then develop a preliminary range of solutions at a general level of detail, assessment and evaluation. Development of alternative plans during this planning stage will identify how certain needs can be met with specific corrective measures. Infeasible alternative corrective measures will be eliminated. The final product of this stage will form the basis for determining the scope and direction of planning efforts under Stage 3.

c. Stage 3 - Development of Detailed Plans

Stage 3 emphasizes the detailed assessment and evaluation of a small number of alternatives. The four planning tasks are carried to a level of refinement that assures that each of the plans considered in Stage 3 is formulated in the best possible way to achieve the desired planning objectives, to assure that each of the plans is implementable and to support the selection of the best plan. Extensive coordination with the public and professional technical evaluation will be used to select the alternative plans to be evaluated. This stage of planning will result in the detailed evaluation of an array of alternative water resource plans responsive to study objectives and the problems and concerns of the region.

6. Planning Process

Iteration of the four planning tasks during the planning stages may be necessary to attain an increasing level of detail and refinement. Iteration also permits incorporation of additional information and broadening of the scope of the study as it progresses.

a. Problem Identification

This task determines the range of water and related land resource problems a study will address and establishes planning objectives for the study. It requires the development of a regional profile of environmental, social and economic conditions. The study objectives will guide formulation of alternatives and the regional profile will act as a base condition for determining impacts and evaluating capabilities of alternatives.

b. Formulation of Alternatives

This process develops alternative water resource management systems that respond to identified problems and concerns and to the study area planning objectives. All potential measures available for problem solution will be identified, including those favored by the public. Both structural and nonstructural measures will be incorporated into plans.

c. Impact Assessment

Here, the impacts of alternative plans are identified, described and, if possible, measured. The significant effects of an alternative are of economic, social or environmental consequences and likely to have a material bearing on the decision making process. The geographical location of each impact should be identified. In addition, it will be necessary to establish the point at which impacts are expected and their duration.

d. Evaluation

This function determines the total beneficial and adverse contributions of each alternative plan. Plans are analyzed to determine their consequences, both beneficial and adverse, and are compared to the "without" condition, what would happen if no plan is implemented. Relative contributions of the alternative plans are then ranked and traded off based on professional analysis and the perceptions of the public. At the conclusion of the planning process, evaluation results provide the basis for selecting the most desirable plan and, if appropriate, recommending its implementation.

7. Data Base Development

Data needed to perform major work tasks will be generated as early in the study as practicable, and data developed as part of the Section 208 planning programs will also be available. Efforts required in the basic study areas of the planning process are described briefly in the following paragraphs.

a. Socio-Economic Studies

Present and future socio-economic conditions in the study area are being identified and developed in the Section 208 planning process. Population projections to year 2030 and economic data including industrial growth trends will be used to assess and evaluate alternative water resources plans.

b. Land Use Studies

Land use studies prepared for the Section 208 projects will be utilized in the development of comprehensive water resources plans. Data developed by local or regional agencies will be considered in the assessment of present and future conditions.

c. Institutional Arrangements Study

A preliminary survey of major public institutions was completed during preparation of the reconnaissance report. A more detailed survey will be conducted during Stage 2 to develop pertinent data on task capability potential of the various Federal, State, regional and local public institutions in the study area. Organization charts, annual reports, legislation, capital budgets and other public documents will be scrutinized to develop a data base on each agency's legal authority, functional role, spatial authority, program responsibility, manpower, organizational structure and financial structure. The institutions' capabilities to implement each alternative plan will then be evaluated and decisions will be reached about continuing or modifying existing institutions and legislation or abandoning existing institutions to facilitate plan implementation.

SECTION IV

STUDY EFFORT ALLOCATION

SECTION IV - STUDY EFFORT ALLOCATION

A. ALLOCATION OF WORK ITEMS

This section describes the work items that will be considered together with an appropriate schedule for their timely completion. The study responds to the two major concerns previously identified: water supply and water quality-wastewater management. The study will also respond to those concerns identified in navigation, recreation or flood damage reduction.

The State of New Hampshire, in coordination with regional planning agencies in the study area, has overall management responsibilities for the wastewater work items; and the water quality work item which will be examined under Section 208 planning, as noted earlier. The Corps will maintain management responsibilities for the water supply work item. Section 208 and water resource planning efforts will be coordinated and integrated to avoid duplication of work and to insure an exchange of information among the study teams.

B. MAJOR WORK ITEMS

While each of the major work items is described individually in this section, actual plans will be developed concurrently in order to formulate the best overall solution. Efforts on major work items are discussed under the four planning tasks outlined earlier.

1. Water Supply

a. Problem Identification

As discussed in earlier sections, all but five of the towns in the SENH area face potential water supply shortages. Regional public water supply demands are estimated to increase from a 1977 total of 17 mgd to about 50 mgd by 2030. Existing water supply systems have a safe yield of 31 mgd.

Water supply data to be collected in the study's subsequent stages will include detailed definition and mapping of all pertinent groundwater and surface water sources. This work will entail including recharge and discharge areas; analyses of drawdown capacity of aquifers; and influence of groundwater withdrawals on surface water supplies. All existing local and regional water supply information will be analyzed.

Earlier proposals for additions to existing water supply systems, both public and private, will be located; and descriptions of principal physical facilities, systems capabilities, seasonal operating

characteristics and sources of supply will be examined. In defining supply sources, data will be obtained on location, quantity, type of facility, owners, service area, usage, quality and treatment costs. Usage will be identified for the following categories: domestic, commercial, industrial, municipal and unaccounted-for water. Future needs--quantity and quality of water required at specific locations--will be determined based upon projections of population and economic growth. Data collection will rely heavily on existing information and input provided as part of the Section 208 program with new source data to be obtained where necessary. All work will be coordinated with current and proposed data collection programs of municipal, regional, State and Federal agencies.

Town-by-town demand and supply projections will be made on a decennial basis to the year 2030. The capability of existing and proposed systems will be compared with projected water demands. Based on demand projections, water supply surpluses or deficits will be calculated for each regional water supply alternative. The following subsections give a brief overview of the region's ground and surface water resources.

b. Groundwater Potential

Several studies have assessed groundwater availability in the study area and most have involved some field work, but information is fragmented. To determine the amount of groundwater available for municipal water supply, the existing information will be utilized and any additional data required will be generated during the early stages of our study.

Surficial geologic maps and groundwater information for 31 of the communities in the eastern and central study area were prepared and compiled by the U.S. Geological Survey (Bradley, 1964). Groundwater favorability maps for 20 of these 31 communities were prepared by the New Hampshire Office of Comprehensive Planning and the Strafford-Rockingham Regional Council. The favorability maps were refined from Bradley's work on the basis of additional well pumping data. Soil surveys of Rockingham County and Strafford County were used as sources for the identification of aquifer locations in another 14 communities. Various reports by Weigle (1969), Goldwaithe (1968), and the Southeastern New Hampshire Regional Planning Commission (1975) were used as source material for part or all of 5 communities. Recent work by Cotton (1977a; 1977b) also contributed to the knowledge of groundwater in the area.

This existing information was used to deliniate potential municipal supply aquifers in the study area. Aquifers consisting of stratified sand and gravel deposits with approximately 50 feet or more of saturated thickness and a surface area of one-tenth of a square mile or greater were considered as potential sources. Aquifers will have to be more precisely located and the safe yields determined. The data must be defined in three phases.

Phase one of this effort, already completed, consisted of a field verification of the location and an onsite evaluation of current land use at each of the aquifer sites. The aquifer delineations were then revised accordingly.

Phase two of the groundwater study would consist of field investigations of aquifers in those communities where water shortages are anticipated prior to the year 2030. This investigation will focus on geological properties necessary to determine the potential yields of the aquifers. Such properties include sediment type, median grain size, degree of roundness, degree of sorting and other lithological and morphological properties.

Phase three would determine the sustained yield from the potential sources identified in phases one and two. Sustained yield is defined as groundwater that can be removed on a continuous basis without permanently depleting groundwater storage or decreasing streamflow below the 95-percent flow duration. The yield will be determined using regional and local watershed geologic and hydrologic data generated in phase two. The field work will include geophysical exploration as well as possible local field testing.

The State of New Hampshire and several private contractors are now conducting investigations into various aspects of wells drilled in bedrock. Hydraulic fracturing of crystalline bedrock to improve well yield is progressing in the Dover-Durham area. This work is still in the research and development stage. Significant findings will be considered during our development of water supply alternatives.

The results of the various phases of this development effort will be depicted on maps showing area, distribution, depth, saturated thickness and potential yield of the aquifers under investigation. This information will then be used to develop integrated surface and groundwater alternatives for the southeastern New Hampshire study area.

c. Surface Water

Communities within the SENH area lie within three major river basins, the Merrimack, New Hampshire Coastal and the Piscataqua. The New Hampshire Coastal Basin is the smallest, draining approximately 55 square miles of the study. Approximately 173 square miles of the study area drain into the Merrimack River. The largest portion of the study area--776 square miles--is drained by the Piscataqua River. The two basins of major concern in this report are the Piscataqua and New Hampshire Coastal, which together account for 831 square miles or 83 percent of the 1,000-square mile study area.

There are seven major streams draining the study area: the Bellamy, Cocheco, Exeter, Lamprey, Oyster, Piscataqua and Salmon Falls Rivers. All lie within the Piscataqua River Basin. The Salmon Falls and Piscataqua Rivers form the New Hampshire-Maine State boundary. Three of these rivers--the Exeter, Lamprey and Oyster--are tributary to Great Bay; the Bellamy River is tributary to Little Bay. The bays flow northward, Great to Little, and empty into the Piscataqua River. Formed by the confluence of the Cocheco and Salmon Falls Rivers, the Piscataqua is completely tidal as are Great and Little Bays.

- Bellamy River rises in Swains Pond in Barrington, New Hampshire and flows easterly to the Bellamy Reservoir, a water supply source for Portsmouth, and continues easterly to Dover. At Dover, the river flows south to its mouth at Cedar Point in Little Bay. The river's total watershed is 35 square miles, and the 4-mile stretch from Dover to Little Bay is completely tidal.

- Cocheco River rises in New Durham, New Hampshire in the southern slope of Birch Ridge. It flows in a southeasterly direction for 34 miles to its confluence with the Salmon Falls River in Dover, New Hampshire. The river's total watershed is 180 square miles and the lowest 2.8 miles are tidal. The Isinglass River, which rises in Bow Lake, is a major tributary of the Cocheco River. It has a total length of approximately 14.5 miles and drains an area of approximately 64 square miles.

- Exeter River rises in Chester, New Hampshire and flows easterly to Exeter, where it turns north and flows into Great Bay. The total watershed area is 129 square miles, and the lower 7 river miles are tidal. (The tidal portion of the Exeter River is known as the Squamscott River.)

- Lamprey River rises in Northwood, New Hampshire and flows easterly to Epping, northeasterly to Durham, then southeasterly to its mouth in Great Bay in Newmarket. Its total length is 42 miles, and it has a total watershed of 211 square miles. The river is tidal from Newmarket to Great Bay.

- Oyster River rises in Barrington, New Hampshire and flows southeasterly to Durham, emptying into Great Bay at Durham Point. The river is tidal to the tidehead dam in Durham and has a total watershed of 32 square miles.

- Piscataqua River is formed by the confluence of the Cocheco and Salmon Falls Rivers. It flows southerly for 4 miles and then southeasterly for approximately 9 miles to its mouth in the Atlantic Ocean. The entire river is tidal, and approximately 9 miles above its mouth it receives flow from Great and Little Bays.

- Salmon Falls River rises in Great East Lake in Wakefield, New Hampshire and Acton, Maine and flows southerly 36.5 miles to its confluence with the Cocheco River. The total watershed of the river is 330 square miles, of which 114 square miles are in New Hampshire. The lower 3.7 miles of the river are tidal.

Many of these streams' natural low flows may be too low to support water supply needs. If the flow is too low, storage would be required in order to use these surface waters for water supply to the region in the future.

The Corps has already completed preliminary review of 49 possible reservoir sites identified by the Soil Conservation Service (SCS) in the North Atlantic Regional Water Resources Study. SCS surveyed each site, insofar as roadway access permitted, to determine site characteristics, developments and general impacts. Each site was evaluated on the basis of engineering, environmental, economic and social aspects. The information obtained and developed in this investigation is to be used in decision processes regarding short and long-range planning. No attempt was made to evaluate the feasibility of the reservoirs in the development of water supply alternatives to serve the region. The report merely identifies those sites deemed appropriate for consideration as potential water supply sources. No attempt was made to eliminate any sites from consideration.

In addition to the streams and potential reservoir sites identified by SCS, Bellamy Reservoir will be evaluated as a potential water supply source along with out-of-basin sources such as the Merrimack River and Lake Winnipesaukee.

The study area has an abundant surface water supply. The goal of the SENH study will be to determine the most efficient method of integrating surface with groundwater supplies to utilize the region's water resources to their maximum potential.

d. Plan Formulation

The study team will develop alternatives focusing on groundwater-surface water resources, either singly or in combination. Also, the possibility of groundwater recharge programs, reuse of industrial wastewater effluents and potential reuse of treated stormwater runoff will be investigated and incorporated in the water resource plans where deemed feasible. Nonstructural measures such as seasonal user fees, water conservation programs and use of water conserving applicances will also be studied. Completion of development of alternatives will be contingent upon development of areawide waste treatment management plans. The level of detail of these alternative plans will not provide the necessary information on local treatment facilities and distribution requirements within communities themselves. The plans to evolve from this study will emphasize a regional network directed toward equalizing distribution of supply among localities, using the most cost effective methods.

e. Impact Assessment

Impacts will be assessed for those localities where economic, social or environmental patterns would be altered. Specific changes to be created by an alternative, expansion of industrial centers, changes in stream ecology or limitations on community development, for instance, will be identified, traced and measured in comparable units. Changes in water rights law and modification or expansion of existing institutions required to implement an alternative will be outlined using information gathered from the institutional arrangements study.

f. Evaluation

Evaluation will determine whether the specific changes from the area's base conditions caused by each alternative are adverse or beneficial. The attainment of study objectives (economical, equitable supply of dependable high quality water through the year 2030) will be measured for each alternative. Water supply alternatives for the NED (National Economic Development) and EQ (Environmental Quality) plans will be selected. Choices between alternatives and potential trade-offs among alternatives will be described and presented for full public review.

2. Water Quality and Wastewater Management

As discussed earlier the State of New Hampshire, in cooperation with regional agencies, has assumed responsibility for wastewater management planning in the study area for this work item. Water quality falls under the auspices of EPA's Section 208 planning so plan development in the study will be fully coordinated with the wastewater management and water quality studies. Results from each of the studies will be applied where relevant.

C. SCHEDULING

As noted previously, the Southeastern New Hampshire Water Resources Study will be undertaken in three time-phased stages. This will help facilitate management by specifying at least three points for monitoring study progress and scope while providing for the orderly development of plans.

Components of the major work items were listed so that time schedules, task sequence and cost allocations could be developed. The proposed schedule for the entire study, shown on Plate 6, has starting and completion dates of the various tasks to assure their completion in time to begin subsequent tasks. This overall schedule was designed to accommodate the most realistic funding schedule now envisioned for this study. The tentative schedule for wastewater management planning in the study area calls for completion by June 1979. Intermediate results will be continually documented during the study.

D. STUDY COSTS

The Corps has estimated the cost of the major work items shown on the work schedule. Because of the water quality and wastewater management work being assumed by the State of New Hampshire, all costs are entirely Federal. No cost sharing is required for accomplishment of the study.

The overall study effort is estimated at $750,000. The study is based on the following funding schedule.

FY 1978	$ 50,000
FY 1979	$130,000
FY 1980	$128,000
FY 1981	$442,000

The major portion of the work effort and funding will be spent on water supply.

E. FINAL REPORT

The final report will consist of a summary report and the following supporting appendices:

- Problem Identification
- Formulation, Assessment and Evaluation of Detailed Plans

- Public Views and Responses
- Engineering Investigations, Design and Cost Estimates
- Recreation and Natural Resources
- Social and Cultural Resources
- Economic
- Others as needed

Continuous drafting of these reports will be required throughout the progress of the study to assure that study progress and findings are given a maximum amount of public exposure. The product of Stage 2 will be the draft Background Information Appendix and a chronological draft of the Plan Formulation Appendix. The analyses of these study documents by all study participants will form the basis for decisions during Stage 3 planning.

FY 77 | FY 78 | FY 79 | FY 80 | FY 81

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STUDY MANAGEMENT

SECTION 208 WASTEWATER MANAGEMENT

SECTION 208 WASTEWATER MANAGEMENT

PROBLEM IDENTIFICATION

PREPARATION OF DRAFT RECON.

RECON. REVISIONS AND SUBMIT TO OCE

PRELIMINARY FORMULATION OF ALTERNATIVES

PRELIMINARY IMPACT ASSESSMENT

PRELIMINARY EVALUATION

INITIAL PUBLIC CONTACT

QUANTIFY WATER SUPPLY REQUIREMENTS

QUANTIFY FLOOD PROBLEMS CAUSED BY FUTURE URBANIZATION

PRELIMINARY IDENTIFICATION OF ALTERNATIVE WATER RESOURCE MEASURES TO SATISFY STUDY AREA NEEDS

PRELIMINARY IDENTIFICATION & FORMULATION OF ALTERNATIVES TO SATISFY NED, EQ OBJECTIVES AND PUBLICLY PREFERRED PLANS

PRELIMINARY IDENTIFICATION OF SOCIO-ECONOMIC & ENVIRONMENTAL IMPACTS

PRELIMINARY ASSESSMENT OF SOCIO-ECONOMIC & ENVIRONMENTAL IMPACTS

PRELIMINARY EVALUATION OF ALL FEASIBLE ALTERNATIVE MEASURES

PRELIMINARY EVALUATION OF ALL ALTERNATIVE PLANS

INITIATE WORKSHOPS & INTENSIFY PUBLIC INVOLVEMENT PROGRAM

OBTAIN PUBLIC PREFERENCES FOR DEVELOPMENT OF INITIAL PLANS

PUBLIC PRESENTATION OF PRELIMINARY PLANS

CHECKPOINT CONF. MID-STAGE PUBLIC MEETING

FINALIZE WATER SUPPLY REQUIREMENTS

FINALIZE FLOOD PROBLEMS

REFINE ALTERNATIVES TO SATISFY NED, EQ OBJECTIVES AND PUBLICLY PREFERRED PLANS

REFINE IMPACT AND ASSESSMENT OF ALL ALTERNATIVE PLANS

REFINE EVALUATION OF ALL ALTERNATIVE PLANS

PRESENTATION OF REFINED PLANS TO OBTAIN PUBLIC REACTION

PUBLIC PRESENTATION OF FINAL PLANS

REFINE FINAL NEEDS

DEVELOPMENT OF FINAL IMPLEMENTATION PLANS

ASSESS DIFFERENCES BETWEEN NED, EQ PLANS AND PUBLICLY PREFERRED PLAN

DETERMINATION OF SELECTED PLAN

PUBLIC REACTION TO SELECTED PLAN

CHECKPOINT CONF PUBLIC MEETING (IF REQUIRED)

CIRCULATE DRAFT REPORT

INCORPORATE COMMENTS

RECEIVE COMMENTS

FINALIZE

FINAL REPORT

M/S 02 M/S 03 M/S 04 M/S 05 M/S 06 M/S 07 M/S 08 M/S 09 M/S 10 M/S 11

A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O

STAGE 1 DEVELOPMENT OF RECONNAISSANCE REPORT

STAGE 2 DEVELOPMENT OF INTERMEDIATE PLANS

STAGE 3 DEVELOPMENT OF DETAILED PLANS

CY 1977 | CY 1978 | CY 1979 | CY 1980 | CY 1981

SOUTHEASTERN NEW HAMPSHIRE WATER RESOURCES STUDY

WORK SEQUENCE DIAGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 6

SECTION V

PUBLIC PARTICIPATION PROGRAM

V. PUBLIC PARTICIPATION PROGRAM

In the broadest sense, the "public" consists of non-Corps of Engineers entities--Federal, State, local and regional agencies--as well as public and private organizations and individual citizens. The public identified during preparation of this reconnaissance report may be categorized into three distinct, yet related groups--the government sector, special interests groups and the public at large.

A. OBJECTIVES

The public participation program is intended to provide a continuous two-way communication process which will maximize the opportunity for the public to 1) be involved in the overall planning process, 2) be aware of the study progress, and 3) assist in making decisions that would have impacts on the lives of those in the study area. Inasmuch as major decisions made throughout the conduct of the study will be based upon the expressed needs of local, county, State and regional officials and the general public, it is necessary to establish a mechanism to channel information to interested participants and to funnel their responses to those conducting the study.

B. STRATEGY

The public involvement program will be implemented during each study phase. In addition to formal public meetings, both progress and information meetings will be held to maintain close cooperation with study participants and to keep them up-to-date and involved. The Corps will try to select meeting locations in those locales that would be most affected by the various resource alternatives. The progress of the study from the initial phase (Problem Identification/Reconnaissance Report) through Phase III (Development of Final Plans) will require the iteration of planning activities at successively greater levels of detail, effort and refinement. At each stage the four planning activities-- problem identification, formulation of alternatives, impact assessment and evaluation--will be carried to the appropriate level of detail.

1. Problem Identification

Public participation in the Southeastern New Hampshire Water Resources Study was initiated in April 1978. Letters were mailed to municipalities and other interested agencies and individuals informing them of the study and its general focus and inviting their views of problems and concerns in the study area. In August the Corps awarded a contract to the Strafford-Rockingham Regional Council (SRRC) to develop a program of workshops. These were intended to explain the status of the study and afford the public an opportunity to suggest and discuss specific issues and concerns that should be investigated.

Public workshops were held in Portsmouth on 7 September, in Dover on 11 September and in Salem on 12 September 1978. They were publicized through the local electronic and print media and by direct mailing to 1000 town and public officials. Altogether, 67 individuals attended the three meetings. Each was provided with a handout explaining the Corps' program and suggested areas of interest. Display maps were provided by the Corps depicting the study area by river basin and municipalities now served by public water supply systems.

The executive director of the SRRC opened the meetings, and the Corps project manager explained the scope and purpose of the study. They kept their opening comments to less than 15 minutes to focus the meeting on maximum audience involvement and participation. A good portion of each workshop, however, was taken up by the persons at the head table in responding to questions and providing background and perspective. In addition to the Corps and SRRC representatives, officials of the New Hampshire Office of Comprehensive Planning, Water Supply and Pollution Control Commission and the Water Resource Board were seated at the head table.

The workshop announcements attempted to focus attention on possible water resource problems other than water supply shortages, which had already been identified as a problem in earlier regional studies. Despite this attempt, water supply was the main topic at all three of the public workshops. The proceedings of the workshops were published in a report,"Public Participation - Summary Report."

At the first workshop, held in Portsmouth, attention centered on developing a regional solution to satisfy regional water supply needs. Concern was expressed that identifying reservoir and aquifer sites on a town-by-town basis might miss the regional concept needed to supply the entire study area. Interest was expressed in an integrated ground and surface water plan from which an acceptable regional plan could be developed.

Although the second workshop, held in Dover, also focused on water supply, interest centered on determining what control towns have over development of their water sources to serve surrounding towns. Another issue discussed was whether towns with additional water sources should fully develop those sources before considering the development of a regional system.

The third workshop, held in Salem, elicited concern not only with finding additional water sources but also about protecting existing ones from the rapid development underway in the area. The community of Salem, which has an immediate need for additional sources of water, has hired a consultant to evaluate its potential for groundwater development.

This series of public workshops, together with a number of coordination meetings with State and Federal officials, has reaffirmed the growing need for a comprehensive surface and groundwater supply plan with short and long-term solutions for the study area.

Before any groundwater alternatives can be proposed, however, a more detailed investigation of its availability must be made. The need for this type of investigation was raised at each of the workshops. Only if this investigation is carried out and the results are incorporated with the surface water alternatives can a complete and detailed set of alternatives be developed. An integrated surface and groundwater assessment has never been developed for the study area, and for this reason none of the proposed water supply alternatives to date have been implemented. Water conservation and water reuse also were suggested as possible measures warranting further study.

2. Formulation of Alternatives

As the alternative plans are developed, public review and comment will be sought through informational brochures, public workshops and informational meetings to insure that all the problems and concerns of the public are addressed. One method of keeping the public up-to-date, suggested at the workshops, is a series of feature stories in the local newspapers. As the study progresses, this method will be considered.

3. Impact Assessment

Public involvement activities during impact assessment will focus on identification and evaluation of the various impacts associated with the water resource plans that are developed for the study area. During this phase the study team will make particular efforts to fully inform the public of all the impacts. Efforts will also be made to identify special interest groups, primarily those concerned with various classes of impacts, so that those groups or individuals can be specifically consulted during evaluation.

4. Evaluation

Public involvement activities during the evaluation of alternatives will be geared toward obtaining the public's views on the acceptability of the proposed solutions. This would also be the time to discuss any disagreements with an aim towards arriving at a mutually satisfactory solution.

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

SECTION VI - CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

In the study area, the major existing problems appear to be water supply and water quality. The main emphasis of the Southeastern New Hampshire Water Resources Study (SENH) will be directed towards water supply. The State of New Hampshire has been given the responsibility of handling the water quality work.

Public water supply systems within the SENH area supplied about 17 million gallons per day (mgd) in 1977, from a system with a safe yield of 31 mgd. Preliminary estimates of future supply requirements indicate an increase to 50 mgd in the next 50 years. By the year 2030 the SENH study area is expected to have a net deficit of 20 mgd.

Water quality and wastewater management work is being handled under the provisions of Section 208 of PL 92-500, the Clean Water Act. The Lakes Region and the Southern Rockingham Regional District Commission are the only two designated 208 areas in SENH.

Flood damage reduction, navigation and recreation will be addressed during the course of the study. However, as a result of the series of workshops held in September 1978 and subsequent meetings with State officials as well as a result of preliminary investigations these water resource components are not as serious a problem as water supply. These three components are already being handled in part by both the Federal and State governments.

Flood damage reduction is being addressed by the Office of State Planning.

Nine Federal navigation projects are located in the SENH study area. Maintenance for these projects is the responsibility of the Federal government. The town of Exeter has requested that the Exeter River be re-dredged to its original depth. This request will be evaluated to determine its feasibility and priority with respect to the other Federal projects.

Recreational plans for the SENH area are addressed in the State's "New Hampshire Outdoor Recreational Plan." The demand for water-related recreational plans is increasing as the population increases. The State report identifies these needs and proposes various future recreational goals for the SENH area.

B. RECOMMENDATIONS

The Division Engineer recommends that study efforts proceed with the initiation of Stage II as outlined in this Reconnaissance Report.

APPENDIX A

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

RESOLUTION

Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Land and Water Resource of the New England-New York Region, transmitted to the President of the United States by the Secretary of the Army on 27 April 1956, and subsequently published as Senate Document Number 14, Eighty-fifth Congress, with a view to determining the advisability of improvements, particularly in the New Hampshire Coastal Area and the Piscataqua River Basin within New Hampshire, in the interest of water supply, flood control, navigation, water quality control, recreation, low flow augmentation, and other allied water uses in this rapidly urbanizing area.

Adopted: September 23, 1976

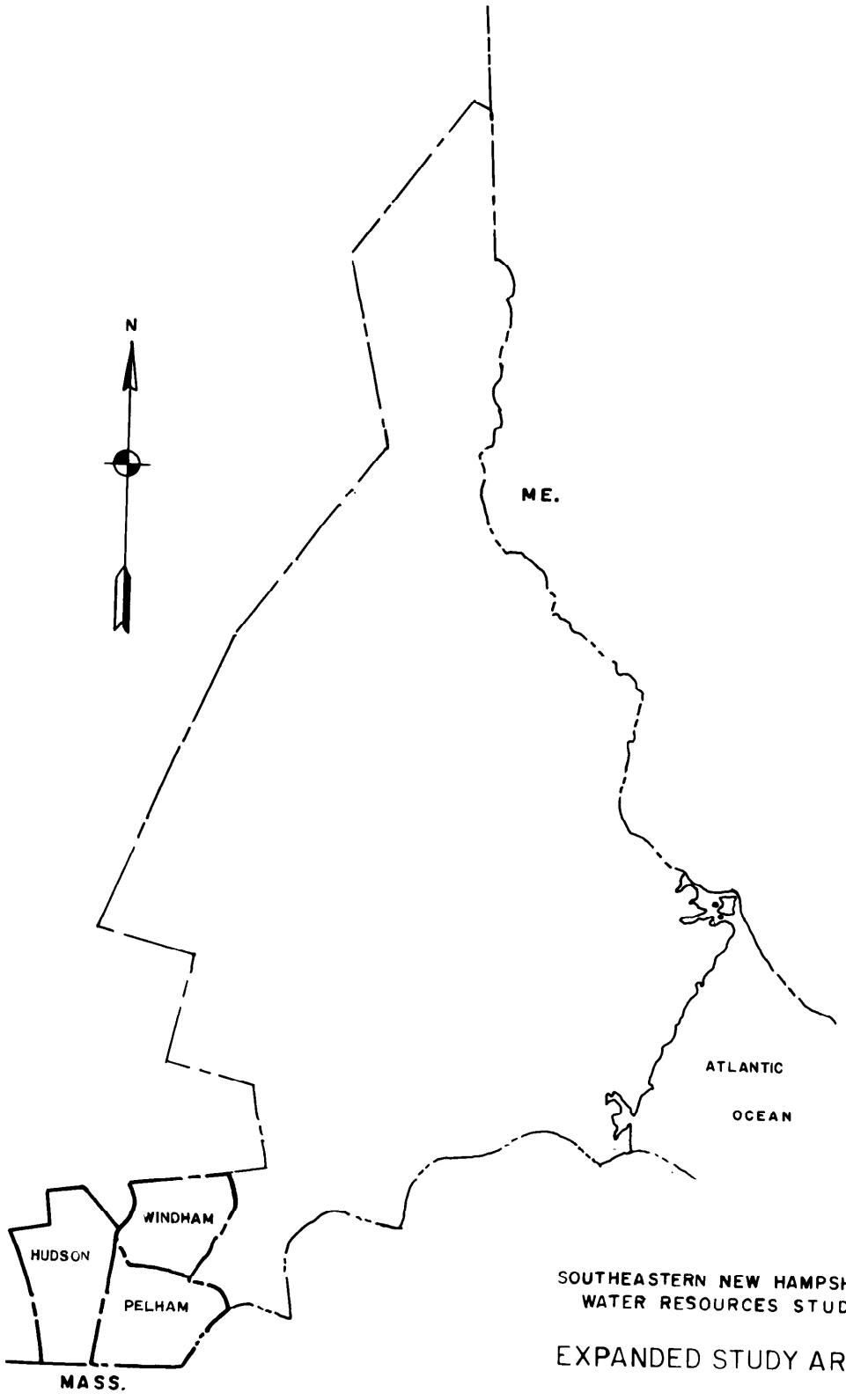
ATTEST: Robert E. Jones

Chairman

U.S. GOVERNMENT PRINTING OFFICE 81-491-A

Requested by: Hon. James C. Cleveland

APPENDIX B



SOUTHEASTERN NEW HAMPSHIRE
WATER RESOURCES STUDY

EXPANDED STUDY AREA

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE B-1

APPENDIX C

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P. O. BOX 1518
CONCORD, NEW HAMPSHIRE 03301

November 8, 1978

Colonel John F. Chandler
Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02203

Dear Colonel Chandler:

This report is intended to aid you in your planning for the Southeastern New Hampshire Comprehensive Water Resources Study. Your study is authorized by House Resolution of September 23, 1976. A plan of study is being developed in coordination with local, state and federal interests. This report was prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C et seq.), in coordination with the New Hampshire Fish and Game Department.

The comprehensive study will include problem indentification and development of possible solutions for water supply, flood control, navigation, water quality control, recreation, and low flow augmentation. The study area includes 47 towns in southeastern New Hampshire encompassing a total of 960 square miles of land and about 38 square miles of standing water. Two towns are located in Carroll County, twelve in Strafford County and thirty-three in Rockingham County.

The study area includes the Piscataqua River, Hampton Falls River, Taylor River, Little River, and a number of smaller brooks. The Piscataqua River, the largest watershed, includes Great Bay and Little Bay encompassing at least 6,000 acres and a number of streams tributary to these bays. The Piscataqua River is tidal along its thirteen-mile length downstream from the confluence of the Cocheco and Salmon Falls River.

The inland portions of the study area are hilly uplands that rim the gently rolling coastal plain making up most of the coastal area. The shoreline zone has relatively flat topography and Portsmouth, Rye, and Hampton harbors provide the primary facilities for many commercial and recreation boats. The Seabrook and Hampton marshes comprise the largest saltmarsh area but smaller saltmarshes and tidal flats are common elsewhere, especially in the Great Bay area. Portsmouth and Rochester are the largest of 50 cities and towns in the study area. Southeastern New Hampshire is attracting large numbers of people, and the southern border towns in particular have rapidly increasing populations. There is increasing pressure for industrial development as well.

Inland fisheries resources consist of many miles of streams that are typically gently flowing. Most of these streams support fish species such as smallmouth and largemouth bass, chain pickerel, white perch, yellow perch, bullhead and several minnow species. Many streams are stocked with brook trout and rainbow trout to support an intensive demand for these species. These streams are listed on Table I. Most of the stocked streams are small with limited summer flow. As a result they are capable of supporting trout only during the spring and early summer.

Almost all the rivers and some brooks that enter salt water are now supporting anadromous fish or sea run trout, or have the potential to support such runs. These streams include the Lamprey, Hampton Falls, Taylor, Cocheco, Bellamy, Oyster, Exeter and Winnicut Rivers and Berry's Brook. The Exeter, Oyster, Bellamy, Taylor and Lamprey Rivers have dams near tidewater that are equipped with fishways. The Lamprey, Cocheco, and Exeter rivers have potential for restoration of American shad. Alewives now migrate into the Lamprey, Cocheco, Oyster, Taylor and Exeter rivers. The Lamprey River also supports a run of coho salmon and an experimental stocking of Atlantic and Chinook salmon is underway.

Commercial fishing boats land their catch at Portsmouth, Rye and Hampton Harbors. These harbors also are used as bases for charter boats, party boats, and private boats that are used for nearshore and offshore sport fishing. Shoreline fishing for flounder, mackerel, striped bass, pollock, cod and other species is attracting many anglers while tidal flats support recreational digging for softshell clams. Great and Little Bays are well known for recreational fishing and shellfishing.

Waterfowl hunting in Great Bay and at other points along the coast attract numerous hunters. The Bay supports migrant and wintering waterfowl. The extensive Seabrook-Hampton marshes are important for waterfowl, other migrant and resident birds, and supports several species of fish and many invertebrates. There are many inland wetlands which support resident and migrant waterfowl and other wetland associated species including mink, muskrat, and beaver. The wetland areas form an important part of the wildlife habitat and add to the character of the landscape.

The primary big game animal is the whitetail deer found throughout the basins. Pheasant are stocked in some areas and woodcock are found in the frequent alder patches along the streams. There is a relatively large area of agricultural lands which, with interpersed wooded areas, create favorable habitat for rabbits, squirrel and other species.

Any project that might be recommended by this study has a potential to affect fish and wildlife resources, including the coastal and marine resources. Such impacts can range from loss of a restored anadromous fish run to degradation of the flood reduction capacity of a wetland. The magnitude of the impact will depend upon the type of project and the nature of preliminary planning.

A requirement of environmentally responsible planning is knowledge of the resource being planned for. Almost any project that might result from these studies will affect water and water associated resources. Detailed information for all types of wetlands would be useful in project planning. Stream flow requirements for fish and wildlife should also be determined. We propose that your study include investigations outlined in the following paragraphs.

The National Wetlands Inventory being conducted by this Service is in progress for the Portland N.E., and S.E. map areas at the 1:100,000 scale and for Boston N.E and N.W. areas. Interpretation of photos is expected to be completed before the end of 1978. These maps cover a part of the study area. The remainder of the study area is located on the Portland SW map and the wetlands inventory for that area has not been scheduled.

Information that can be developed from the survey includes classification of wetlands over 3-5 acres; determining dominant vegetation; associated plant species and wildlife using the wetland, the water regime and possibly determining soil types. This kind of information will be useful to any future investigation of water resources and will be necessary to protect wetlands (or mitigate their loss) should a proposed project cause adverse impacts.

The general steps needed to accelerate completion of the studies are -

1. Completing photo-interpretations for the study area.

2. Expedite completion of large scale maps (1:24,000 or 1:62,500 scale) delineating wetland areas.

3. Generating wetland information such as watershed, ecoregion, water regime, vegetation, soil types (if possible) and wildlife use.

Due to the importance of wetlands in this area we believe that acceleration of the National Inventory in the study area could be funded with project funds transferred to this Service.

The stream fisheries, including anadromous estuarine fisheries, are entirely dependent upon stream flow that can be adversely affected by many different development activities. For example, withdrawal of ground water can reduce stream flow. Impoundments can do the same thing, especially if the water is diverted to other watersheds. Modifications of existing dams (or their operations) and new dams should not be planned without consideration for maintenance of adequate flows. A change in flow regime that reduces stream flow can restrict fish and wildlife production.

We propose that a determination of stream flow required to maintain optimum conditions for fish and wildlife be included as a part of this study. We would be primarily concerned in determining flow requirements for fish and wildlife. A detailed set of criteria should be established for large streams and perhaps a more general criteria could be set for tributaries. These criteria would be a useful planning tool for future consideration of water resource use in the area.

In summary, anadromous fish potential, the need for fish passage facilities, and stream flow needs, should be major considerations when any project affecting a stream is planned under this study.

Prevention of loss of wildlife also should become a factor in planning. Terrestrial and wetland wildlife resources are especially vulnerable and need to be protected in this section of the state where the human population is rapidly increasing.

Fish and wildlife enhancement and preservation can best be achieved through implementation of non-structural measures to reach goals for flood control, coastal flood damage reduction or other purposes. Establishing open space corridors in areas subject to flood damages or adverse impacts from other causes can help to either avoid or mitigate the damage.

We appreciate the opportunity to comment on the study at this early stage.

Sincerely yours,

Gordon E. Beckett
Supervisor

utilities and facilities and emergency access for a 10-day

The Corps provides emergency response to natural disas

Table 1. Trout Streams[1]

Stream	Town
Armstrong Brook	Kensington
Bellamy River	Barrington
	Madbury
[2]Berrys Brook	Portsmouth
	Rye
Big River	Strafford
Branch River	Milton
	Wakefield
Buzzells River Brook	Strafford
Branch Brook	Candia
[2]Cains Brook	Seabrook
Canning Factory Brook	Greenland
Churchill Brook	Brookfield
Cocheco River	Farmington
	New Durham
[2]Drakes Brook	Hampton
Dudley Brook	Brentwood
Eastman Brook	Hampton Falls
Exeter River	Brentwood
	Chester
	Exeter
Flat Meadow Brook	Northwood
Fordway Brook	Raymond
Gerrish Brook	Madbury
Gig Mill Brook	Brentwood
	Kingston
Great Brook	Milton
Great Brook	Kensington
Hartford Brook	Deerfield
Houston Brook	Chester
Isinglass River	Barrington
	Strafford
Johnsons Brook	Madbury
Jones River	Middleton
Kelly Brook	Plaistow
Knights Brook	Newington
[2]Lamprey River	Deerfield
	Epping
	Lee
Little River	Lee
	Nottingham
Little River	North Hampton
Little River	Plaistow
Little River	Exeter
Mad River	Farmington
Mallego Brook	Barrington
Mohawk River	Strafford
Rickers Brook	Rochester
Murry Hill Brook	Candia
Narrows Brook	Northwood
Nichols Brook	Deerfield
Nilus Brook	Hampton
Nippo Brook	Barrington
North River	Lee
	Nottingham
[2]Oyster River	Durham
	Lee
Pawtuckaway River	Nottingham
Pike Brook	Brookfield
Piscassic River	Epping
	Fremont
	Newfields
	Newmarket
Pleasant Pd.Outlet	Deerfield
Pow Wow River	South Hampton
Ray Brook	Chester
Rome Brook	Newton
Rum Brook	Epping
Salmon Falls River	Rochester
Spickett River	Salem
[2]Taylor River	Hampton Falls
Toll Brook	Chester
Tuttle Brook	Lee
Twombly Brook	Rollinsford
Willey's Pd. Brook	Seabrook
Wilson Brook	Chester
	Sandown
Wimbly Brook	Kensington
Winkley Brook	Hampton Falls
Winnicut River	North Hampton
Yorks Brook	East Kingston

[1] List includes streams in which trout are stocked by the State Fish and Game Department.

[2] Streams supporting anadromous fish, see text.

TABLE C-1

THREATENED OR ENDANGERED FAUNA OR FLORA IN NEW HAMPSHIRE

Species	Scientific Name	Status
Fauna:		
Mammals:		
Indiana Bat	Myotis sodalis	Endangered
Eastern Cougar	Felis concolor cougar	Endangered
Eastern Timber Wolf	Canis lupus lycaon	Extinct*
Blue Whale	Balaenoptera musculus	Endangered
Bow head Whale	Balaena mysticetus	Endangered
Finback Whale	Balaenoptera physalus	Endangered
Gray Whale	Eschrichtius gibbosus	Endangered
Humpback Whale	Megaptera novaeangliae	Endangered
Right Whale	Eubalaena spp.	Endangered
Sei Whale	Balaenoptera borealis	Endangered
Sperm Whale	Physeter catodon	Endangered
Birds:		
American Peregrine Falcon	Falco peregrinus anatum	Endangered
Artic Peregrine Falcon	Falco peregrinus tundris	Endangered
Brown Pelican	Pelecanus occidentalis	Endangered
Light-footed Clapper Rail	Rallus longirostris levipes	Endangered
Kirtland's (wood) Warbler	Dendroica kirtlandii	Endangered
Reptiles:		
American Alligator**	Alligator mississippiensis	Threatened
Fishes:		
Shortnose Sturgeon	Acipenser brevirostrum	Endangered
Flora:		
Milk Vetch	Astragalus robbinsii	Endangered
Small Whorted Pogania	Isatria medeoloides	Endangered
Unexpanded Reed-Bentgrass	Calamagvostis inexpansa	Endangered
Spreading Globe-flower	Trollius laxua	Endangered
Mountain Avens	Geum Peckii	Endangered
Dwarf Clinguefoil	Pontertilla robbinsiana	Endangered
Alpine Rattlesnake-root	Prenanthes boottii	Threatened
Eaton's Quillwort	Isoetes eatonii	Threatened
Pitted Quillwort	Isoetes foveolata	Threatened
Auricled Twayblade	Listera auriculata	Threatened
Reed-Bentgrass***	Calamagrostis nubila	Extinct

* Considered to be exterminated in New Hampshire through bounty hunting. Still survives in Minnesota, Michigan, endangered status.

** The American Alligator is considered "threatened" wherever found in captivity throughout the world, including New Hampshire.

*** Was found on Mt. Washington, date last collected was 1862.

Sources: Federal Register; Fish and Wildlife Service, U. S. Department of Interior.
Frank C. Seymour, The Flora of New England (Charles E. Tuttle Company, Inc. Tokyo), 1969

APPENDIX D

NEW ENGLAND RIVER BASINS COMMISSION

The New England River Basins Commission (NERBC) held a two-day workshop on 20 and 21 September 1978 in Portsmouth, which focused on the Piscataqua River Basin. Discussion at the workshops focused on the opportunities and constraints upon economic development of an interstate river. The purpose of the workshops was to provide the NERBC with the issues and problems of greatest concern to the public for input into the Commission's overview study.

The NERBC has a basin planning program designed to maintain a continuing assessment of the problems, issues and opportunities associated with the region's water resources. Basin overview reports are the initial products of this program.

The Piscataqua River Basin Overview will concentrate on identifying gaps in the existing network of planning and resource management programs, and advances recommendations to correct these deficiencies. As such, it constitutes a guide to additional planning. The overview will also be used to assist in the coordination of State and Federal planning efforts, providing the basis for the investigation of interstate resource issues and support for the Commission's annual priority program.

Coordination meetings have been and will continue to be held with NERBC as this study and their overview study progress.